PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

167-176 TIMES BUILDING, NEW YORK.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 28 Hathaway Building, Boston.
Western Office, 465 The Rookery, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION, IN ADVANCE, ONE YEAR $3.

(Including Postage in the U. S., Canada or Mexico.)

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VOL. XX. NEW YORK, AUGUST 20, 1892. NO. 8.

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Progress of the World's Fair. AS THE time approaches for the more active preparation of intending exhibitors at the World's Fair, manufacturers and others, both in this country and abroad, are taking a more decided interest in the arrangements not only for the allotment of space but for the transportation of passengers and goods and the general accommodations to be provided for visitors in the various departments as well as for exhibitors. A general outline of the work and of the arrangements which are of the greatest interest to electrical engineers and electricians is given in our special Chicago letter, which is contained in our columns this week. The announcements of the allotment of space in the Electrical Building will soon be made by Chief Barrett, and then the work of preparing individual exhibits will doubtless go rapidly forward.

A Conflict of Dates. OUR attention has been called to the fact that the opening exercises of the World's Columbian Exposition at Chicago, which will be held on Oct. 21, occur on the same day as the closing session of the American Street Railway Convention at Cleveland. This conflict of dates will undoubtedly interfere, to some extent, at least, with the success of the Street Railway Convention, since the Western members will desire to attend the opening ceremonies at Chicago, while the Eastern members who have gone as far West as Cleveland will feel disposed to make the short additional trip necessary to give them the opportunity of being present to witness the demonstrations at Chicago. Since the Columbus exercises are to be held in New York City on Oct. 11, 12 and 13, it would seem a good plan to change the date of the Cleveland meeting to Oct. 18, 19 and 20, as the delegates who desired to do so could then leave Cleveland on the night of the 20th and arrive in Chicago in time for the demonstrations of the following day.

Ewing's Magnetic Curve Tracer. IN OUR cable dispatch last week we were able to give a general idea of the ingenious apparatus of Prof. Ewing, which he presented to an interested audience at the Edinburgh meeting of the British Association on the day we went to press. Our readers will find a fuller description of this interesting curve tracer elsewhere in our columns this week, together with illustrations of the apparatus and specimens of the curves produced by it. These curves are taken direct from photographs made by projecting the spot of light upon the sensitized photographic plate. The instrument is, as our cable dispatch announced, a combination of an extremely dead-beat galvanometer and an equally dead-beat magnetometer, the two together producing the curve that corresponds very closely in its character to the indicator card taken from an engine cylinder running under a steady load. The practical application of the instrument is at once evident to all who are interested in the design and construction of dynamos and transformers.

The British Association. OUR columns this week will be found to contain the most important papers presented at the earlier sessions of the British Association, as well as a cable dispatch giving a brief account of the sessions held after our last issue went to press. It was at one of these sessions that the highly important discussion on electrical units, referred to in our telegraphic columns, took place. Although the last session of the Association was held on Wednesday of last week, we are able to give our readers four of the important papers read before sections A and G, in addition to the one by Mr. Preece, given exclusively in the last issue of THE ELECTRICAL WORLD. These four papers are by Prof. Unwin, Mr. Preece, Prof. Schuster and Prof. Ewing, and are given either in full or in abstract. We have good reason to believe that our readers have appreciated our promptness in presenting an exclusive report of this important meeting in this country even before many English readers were able to obtain similar reports in our English contemporaries.

Sun Spot Disturbances. IN A recent issue we gave the result of Mr. Wm. Finn's observations upon the variations of earth currents and the disturbances caused by them upon the Western Union telegraph wires during the prevalence of the magnetic storm of July 16. Another and similar storm occurred on Friday of last week, just 27 days subsequent to the one referred to above. Mr. Finn was a close observer of the disturbances caused by this storm also, and he deserves credit for the promptness with which he has prepared the results of his observations for publication. Through Mr. Finn's courtesy we are able to present to our readers in this issue the observations made on Friday of last week, while the occurrence is still fresh in the minds of many who tried to send messages over the wires during the prevalence of the storm. It will be seen that the maximum difference of potential reached the extraordinary value of 650 volts, this remarkable occurrence taking place on a western wire 481 miles in length. It is reported that the disturbances were noticed on the Atlantic cable lines, and extended even to many parts of England. The storm was certainly an unusual one and is worthy of further investigation.

Electrical Railway Finances. THE figures contained in the synopsis of the annual report of the West End Street Railway Company of Boston, given on another page, are full of interest to the electrical engineer as well as to the capitalist whose money is invested in electric street railways. It is more than likely, too, that they will be of interest to the capitalist whose money is tied up in non-dividend paying horse railroads. The remarkable increase in the net earnings per car mile, shown by the figures quoted, since the introduction of the electric system, must be taken as indisputable proof of what can be accomplished in any large system of street railways operating under the same or more favorable conditions, when the production of electricity on a large scale is undertaken in a business like way. The striking contrast between the net earnings per car mile for the cars operated by horses and electric motors, respectively, is especially noticeable, and is, no doubt, a gratifying result to the stockholders of the West End system. More than 260 miles of track are now controlled by this company, and of this one-half is practically new, as the roadbed has been relaid to accommodate the heavier rolling stock made necessary under the new conditions. Of this mileage fully two-thirds is electrically equipped, and it is expected that by the end of the year seven-eighths of the West End lines will be operated by the trolley system. It is of interest to note that under its present method of operating the company is charging $11,000 per month to depreciation of its horse equipment.

Horse Killers in New York. THE recent intensely hot weather has again made prominent one of the reasons why the replacement of the street car horse by the electric motor is desirable. The third avenue road, in this city, is operated as a horse car line, the total equipment of horses being 3,000. Of this number no less than 600 have succumbed to the intensely hot and sultry weather of the last few weeks, while 300 more are in the hospital, suffering from the results of the overwork under the most unfavorable circumstances. Of these 300 it is expected that a very large proportion will prove to be fatal cases. This extraordinary mortality among the horses has not only proved a very serious loss to the company, for at only $100 each the total foots up no less that $60,000 loss already incurred, but the cars of the line, operated by the greatly decreased equipment, are unable to carry the daily traffic, and are, in consequence, obliged to run, to borrow an expression from the railroad man, "on any kind of time." On this line, alone, about fifty cars have been laid off on account of the loss of horse equipment. What is true of this line is doubtless true of many more lines in this and other large cities, although the percentage of mortality may not be quite so large in cases where the regular traffic is not so large, and the cars used are not so heavy. With an electrical equipment the hot weather would not interfere in any way with the running time of the cars, and the increase of the passenger traffic that the hot weather is likely to produce could be easily handled by the running out of some of the spare cars always kept on hand. The surface roads of New York City have experienced a very decided increase in their receipts during the hot weather, while the traffic on the elevated roads has decreased. This is, of course, due to the fact that people find it more convenient to board a horse car to ride a short distance, taking a little more time for the trip, than to mount the stairs to the elevated station, in order to make the trip on the quicker trains of that system. It is safe to say that with an electric system on these surface roads the receipts would be nearly doubled during such hot weather, if not at all times, owing to the greater convenience and pleasanter transportation. The business of the elevated would then be confined to long distance travel almost exclusively. The "emancipation of the street car horse" cannot go on too rapidly.

The Edison Association. THE recent meeting of the Association of Edison Illuminating Companies, held at Toronto, calls to mind the discussion of the proposed amalgamation of these associations with the National Electric Light Association, which was printed in THE ELECTRICAL WORLD of Feb. 27, 1892. Most of those who expressed their views at that time were in favor of this step, especially because the consolidation of the Thomson-Houston and Edison General companies had already made common interests between those operating Edison stations and those in charge of Thomson-Houston, Fort Wayne and Brush plants, if indeed they had not possessed common interests before that time. It seems now, however, that the field of the Edison association is to be broadened so that its membership may include those who control plants operating on any one of the systems of the General Electric Company, and that its plan of organization and the conduct of its conventions will not be materially changed. The idea of this organization has always been that the interests of the parent company and those of the sub-companies were indissoluble, and the closer the union the better for all concerned, and, incidentally, the worse for the companies operating opposition systems. Now that a large majority of the central stations of the country are dependent upon the General Electric Company for lamps and apparatus, it is natural that these companies, including the various Edison Illuminating companies, should cultivate closer relations with each other and with the parent company. It is probable that the same exclusiveness will be maintained in the conduct of the association meetings—or more accurately, conferences—as before, and that at each regular meeting officers of the parent company will be prevailed upon to be present to discuss with the managers of the central stations topics of common interest. At the Toronto meeting last week Mr. C. A. Coffin, President of the General Electric Company, addressed the association, assuring them that the policy of the parent company in its attitude toward the sub-companies would be a liberal one, and that whatever could possibly be done to maintain the present interests of the former competing companies would be carried out. As in the case of former conventions only a brief account of the proceedings of the meeting was given out for publication, the discussions being carried on behind closed doors. This brief report will be found elsewhere in our columns.

The Edinburgh Meeting of the British Association.

(By Cable from Our Special Correspondent.)

EDINBURGH, Aug. 15.—The success attending the first days of the Edinburgh meeting of the British Association for the Advancement of Science, as cabled to THE ELECTRICAL WORLD last week, was continued without interruption until the close of the sessions on Wednesday, Aug. 10.

The important discussions of Monday and Tuesday had served to keep those electricians who were in attendance upon the earlier sessions of the association in the city until the very last of the meeting. These discussions, as has already been announced, were upon the subjects of the establishment of a national physical laboratory, this discussion being led by Dr. Oliver J. Lodge, and upon the internationalization of electrical units and nomenclature.

The public discussion upon electrical units proved to be very much more meagre than had been anticipated, although the session at which this subject was discussed was attended by several distinguished German scientists who had come over from Germany for the express purpose of being present and taking part in the discussion of a subject which they rightly regarded as one of international interest. Among these may be mentioned H. L. F. von Helmholtz, Prof. H. E. J. G. du Bois, of Berlin; Prof. E. Wiedemann, Prof. Lindeck, and Dr. Kahle, of the Imperial Physico-Technical Institute of Berlin; Prof. H. S. Carhart, of the University of Michigan, and Mr. Nikola Tesla.

Although the discussion was meagre, as already mentioned, it ought, however, to be stated that a number of preliminary private conferences had previously taken place during the Edinburgh meeting between the members of the Electrical Standards Committee of the British Association—of which Mr. R. T. Glazebrook is secretary, and such men as Lord Kelvin, Prof. W. E. Ayrton, Mr. W. H. Preece and Prof. Crystal are members—and the distinguished foreigners just referred to. Doubtless, therefore, the important matters upon which the committee is to report and upon which it probably would have reported ere this, had it not before doing so desired to obtain the views of foreign electricians, are already so well settled that a very lengthy discussion in "open meeting" was considered unnecessary.

Prior to the discussion Secretary Glazebrook had issued an advance circular setting forth the outline of the proposed discussion, so that the failure to discuss the matter more fully was not owing to those present being unable to know in advance just what course the discussion would be likely to take. The points considered in the discussion were: The value of the British Association unit in ohms, the specific resistance of mercury in ohms, the subject of standardizing by the electrolysis of silver, the electromotive force of the Clark cell, and the report of the committee for 1892.

In view of the discussion on electrical units, Prof. Oliver J. Lodge had addressed a lengthy letter to the British Association Committee on Electrical Standards, in which he made several sweeping propositions. The two proposals which most nearly concern practical electrical engineers are (1) that the practical unit of electrostatic capacity shall be reduced to one-millionth of its present value, in other words, that what is at present called the microfarad shall in future be called the farad; (2) that the watt shall be transferred from a unit of power to a unit of energy, a volt-ampère hour; so that the British Board of Trade unit, instead of being called a kilowatt hour, would be called a kilowatt.

The entire number of electrical papers presented was much larger than had been anticipated, the number reaching fully two-thirds of the total list of papers read before Sections A and G, the sections devoted to the discussions on questions in physical and mechanical science respectively.

Especial interest has been taken by electricians in the very masterly Presidential Address of Prof. W. C. Unwin, President of Section G, on the "Distribution of Power from Central Stations,"* from the fact that Prof. Unwin, who is so well known as a mechanical engineer, has recently been offered a most tempting salary to take the position of engineer in charge of the Niagara Falls Construction Company. Although the Professor has declined the flattering offer, he continues as consulting engineer to the company, and it is said that he and Prof. George Forbes† will soon start for your side of the Atlantic in connection with the work on the Niagara tunnel. Both, as you probably know, have for a long time been consulting engineers to the company. On this account, the figures regarding the work at Niagara, quoted by Prof. Unwin, are valuable, and electricians are naturally interested to learn from Prof. Unwin how the power is to be transmitted from Niagara.

Prof. Schuster's presidential address in Section A, and the paper he subsequently read in the same section on "The Passage of Electricity Through Gases,"* are very favorably commented upon.

Prof. Ewing's description of his new magnetic curve tracer for automatically recording hysteresis curves attracted, as was expected, very great attention from those present.†

Among those present at the later sessions of the Association in Sections A and G were Prof. W. E. Ayrton, President of the Institution of Electrical Engineers; Mr. W. H. Preece, of the Post Office Department; J. W. Swan, of incandescent lamp fame; Nikola Tesla, Prof. H. S. Carhart, Prof. Silvanus P. Thompson, Mr. Desmond G. FitzGerald, Dr. J. H. Gladstone, Mr. Kerr, Prof. George Forbes, Alex. Siemens, Gisbert Kapp, Prof. Schuster, Prof. W. C. Unwin, Prof. William Crookes, Dr. Oliver J. Lodge, Lord Kelvin and Dr. J. T. Bottomley, of Glasgow.

Ewing's Magnetic Curve Tracer.

At his evening lecture on "Magnetic Induction," delivered on Monday of last week and again on Tuesday, before Section A of the British Association, Prof. Ewing exhibited an apparatus for automatically drawing hysteresis curves, the development of which has been his chief work for some time back. This was briefly described in our cable dispatch in our last issue.

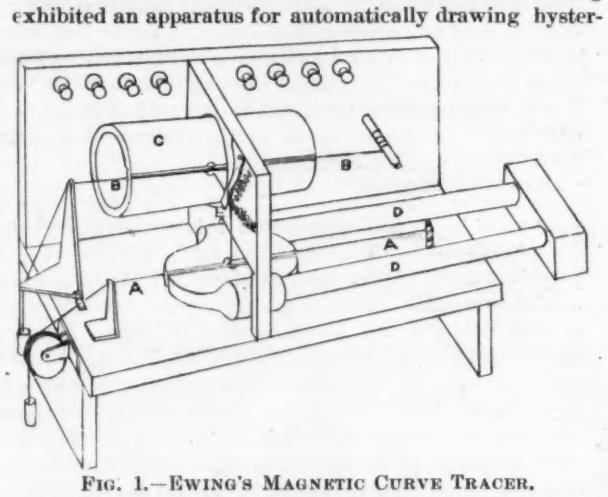


FIG. 1.—EWING'S MAGNETIC CURVE TRACER.

The principle of the apparatus will be seen at a glance. *E* (see Fig. 1) is a mirror, mounted with two degrees of freedom, capable of altitude and azimuth movement. It receives azimuth movement from the wire *BB*, which is stretched in a narrow gap in an electromagnet *C*. It receives altitude movement from a wire *AA*, which is stretched in a narrow gap between the pole pieces of the magnetic circuit *DD*, consisting of the rods to be examined. A constant current is passed through the wire *AA*, and it therefore sags, up or down, proportionally to the field across the gap; in other words, proportionally to the magnetism of *DD*. The variable current which flows in the coils of *DD* passes also through the wire *BB*. Hence, since the field of *C* is constant, *BB* sags out or in, giving the mirror azimuth movement proportioned to the strength of the magnetizing current. *BB*, with its magnet, taken alone, thus forms an extraordinarily dead-beat galvanometer, and *AA* forms an equally dead-beat magnetometer.

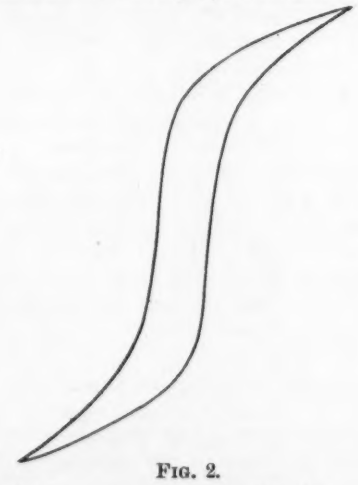


FIG. 2.

The apparatus can be arranged so that a complete **H B** cycle can be gone through in $\frac{1}{10}$th or even $\frac{1}{20}$th of a second, the result being a continuous line of light upon a screen. Small loops on the main curve can equally well be shown. In the form of the instrument suitable for slower use, it will allow of different materials being tested magnetically with the utmost readiness. A cycle can be obtained from an iron bar in a few seconds; then the bar can be taken out, and another bar put in, and its cycle drawn just above the previous one, so that a glance shows the relative hysteresis, relative permeability, and so forth—in fact, all that dynamo makers and transformer builders want to know about iron or steel.

The curves shown in Figs. 2 and 3 are reproduced from photographs of magnetic cycles taken by means of the

FIG. 3.

curve tracer, the light spot being sent direct on to the sensitive plate. The plain cycle (Fig. 2) was taken at the rate of two cycles per second, and the plate was exposed for 15 seconds, so that the curve was traced 30 times. The little ripples due to the inertia of the working parts reproduce themselves in the same places every time, just as in indicator diagrams taken with a steadily running engine. In other words, the same causes produce the same effects every time. Fig. 3 shows some fancy magnetization with loops, and it speaks for itself.

Comparative Merits of the Two-Phase and Three-Phase Systems.

BY C. E. L. BROWN.

The interesting articles by Mr. Kelly and Mr. Steinmetz in THE ELECTRICAL WORLD of July 16, 1892, induce me to add a few words to this discussion.

My extensive experience with multiple-phase currents has shown me that motors for the two-phase and those for the three-phase system for the same output are very much the same machines with regard to their respective efficiency, starting torque, weight and apparent watt consumption. This holds good for synchronous as well as non-synchronous motors, and shows plainly that Mr. Kelly's, as well as Mr. Steinmetz's theoretical deductions are founded on the true basis.

I make use of this occasion to state that Prof. Ferraris, Gisbert Kapp and Mr. Tesla also expressed themselves to that effect in an interview I had with them some time ago.

Again, another proof of the correctness of Mr. Kelly's and Mr. Steinmetz's deductions can, I believe, be taken from the fact that Mr. Tesla, who, as is well known, had already in his first patents brought the three-phase current to notice, nevertheless devotes his special attention to the two-phase current system, and I believe rightly, for as soon as there is a question of distributing electric light and power efficiently, there is no doubt that the two-phase has many advantages over the three-phase current.

This latter system allows a very efficient distribution of power only, but as soon as any light has to be supplied in connection with power, the mutual dependence of the currents presents great difficulties in the way of regulation. The connection, too, of the lamps with the mains becomes naturally rather complicated. All electrical engineers know that already the connection to an ordinary three-wire system is comparatively complicated, but these difficulties increase very considerably with the three-phase system, as with this three groups of lamps will always have to be connected with the three wires.

In using the two-phase current all these difficulties are done away with, as the connections of the lamps can be made similar to those on an ordinary alternate current circuit.

The regulation presents no difficulty whatever, and motors can be driven by this system just as well as by using the three-phase current.

It is therefore my firm belief that in the future the two-phase current will take the lead where combined light and power distribution is required, while the three-phase current may be used for simple power transmission and distribution.

The points I have brought up in the above few lines are not to be taken as merely theoretical, but are proved by experience and many actual tests in practice. I have at the present moment installations in hand for many 100 h. p. for the two-phase system, and I am altering a large installation from the three-phase to the two-phase system, as the same is now required for light in addition to the distribution of power, which was originally intended exclusively.

In reply to the remarks of Mr. Steinmetz, that at the Frankfort installation the small number of periods was taken merely at random, I beg to say that this is not the case, but the number of periods was fixed according to very careful and elaborate tests. With this, however, I do not intend to say that motors with larger numbers of periods could not be produced in practice.

*A part of Prof. Unwin's address will be found in this week's issue of THE ELECTRICAL WORLD.

† A synopsis of Prof. Forbes' paper on "The Turning of Refuse into Electric Light" will be found in this issue.

* A synopsis of Prof. Schuster's presidential address, and also of his paper on "The Passage of Electricity Through Gases," is published in this week's ELECTRICAL WORLD.

† Prof. Ewing's curve tracer is illustrated and its operation described on this page of THE ELECTRICAL WORLD.

New York's First Trolley Road.

THE line which the Union Railway Company is equipping in Harlem has the distinction of being the first trolley road in New York City, a distinction which it bids fair to hold for some little time yet. Any road that establishes itself in New York in the face of the strong opposition which now manifests itself against the trolley system only does so with a hard struggle and certainly earns any success which may crown its efforts.

This road, aside from the fact that it is New York's first trolley line, is not of especial interest, and both in line and station equipment resembles other similar roads throughout the country. The Thomson-Houston system is used. It possesses one unique feature, however, which has unusual interest and which perhaps is found on no other road yet constructed. that is, the attachment of the trolley wire to the structure of an elevated railroad.

This line, which starts at the end of the Third avenue elevated, crosses the Harlem River and strikes the Suburban about 20 squares above, which it follows to the end of the route. Advantage is, of course, taken of the very substantial structure of the elevated road as a support for the trolley wire. The way in which this is accomplished is exceedingly simple, as can be seen from the accompanying illustration, Fig. 1. An inverted wooden trough, which is shown in detail in Fig. 2, is securely bolted to the iron cross braces of the elevated structure, which are as conveniently placed as if they had been designed for this special purpose. The trolley wire is then carried along the centre of this trough, to which it is attached by means of the insulating fixtures shown in the initial letter of this article. This not only affords a more substantial suspension than that ordinarily used, but one which protects the wire from rain and sleet and the disastrous swaying of the wind, as well as from falling wires, poles, etc. While possessing these advantages, its simple construction makes it comparatively inexpensive. The expense and trouble of maintaining poles, cross arms, guard wires, etc., is entirely avoided over this portion of the route.

The objections which are so strongly urged against the introduction of the trolley into New York cannot hold to any extent in the case of this road. Traffic is not so dense in this portion of the city that moderately high speed would prove a menace to human life. The wires, being attached for the major part of the distance to the elevated structure, cannot be said to disfigure the street, as they would not be noticed by the ordinary passer by nor could they prove to be an obstruction to the Fire Department. What is more important, however, they are so completely protected that it is impossible for telephone, electric light or other wires to fall across them, and this will be considered by many to be one of the strongest points in its favor.

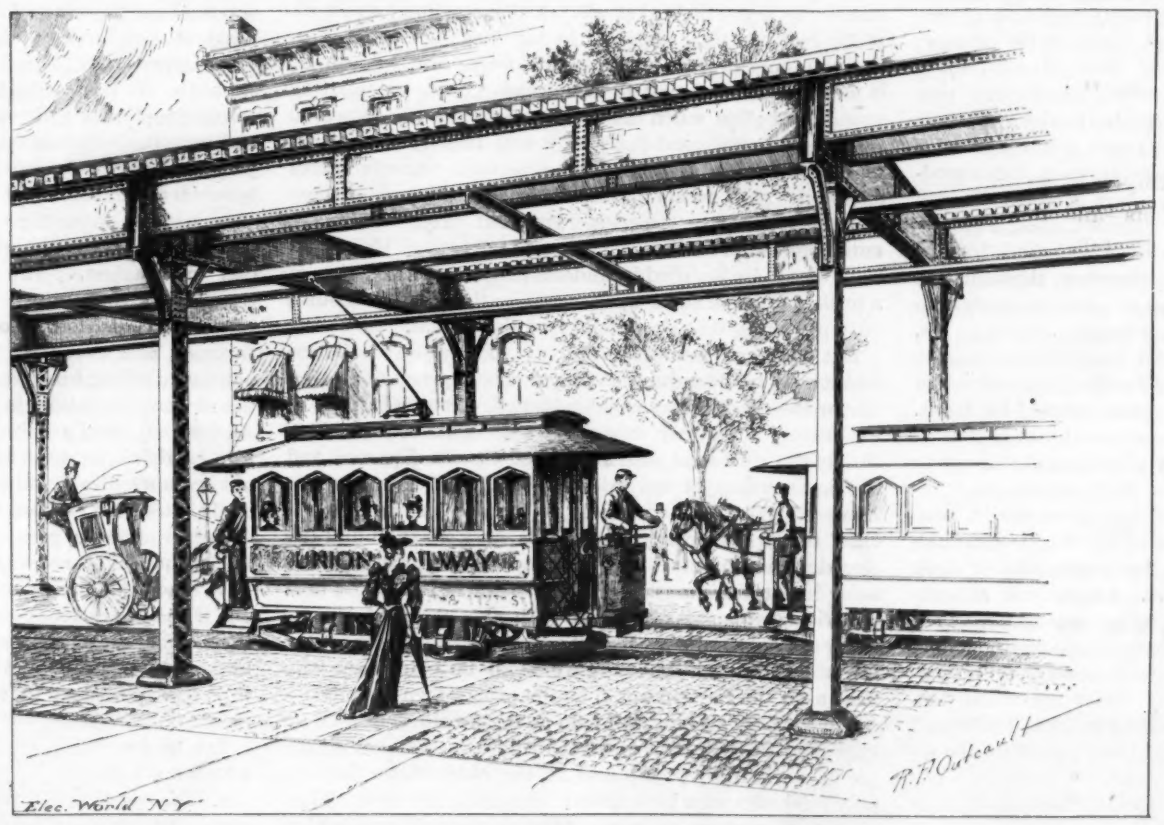


FIG. 1.—NEW YORK'S FIRST TROLLEY LINE.

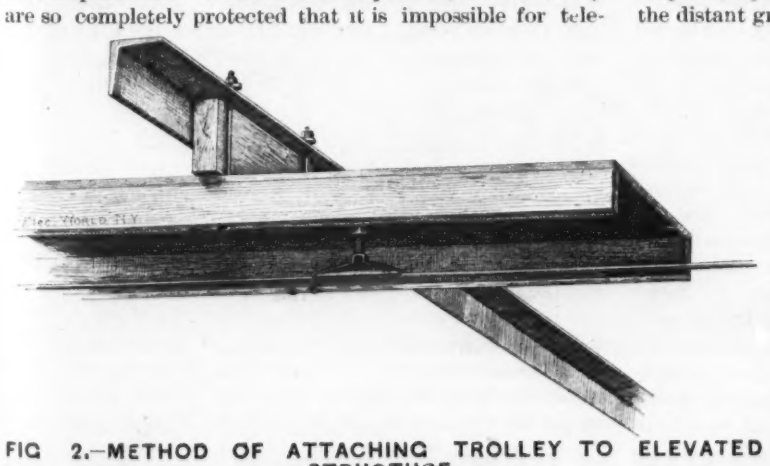


FIG. 2.—METHOD OF ATTACHING TROLLEY TO ELEVATED STRUCTURE.

An Electric Storm Recurrence.

BY WILLIAM FINN.

The same sun spot which was unquestionably concerned in the production of the magnetic storm of July 16 last is probably responsible for a similar disturbance in telegraph lines which occurred Friday last, Aug. 12, and which fairly rivaled its famous predecessor in the extent of territory affected, as well as in the magnitude of the disturbing forces. In many respects, moreover, the characteristics exhibited by the earth currents on the recent occasion were the precise counterparts of those observed in the case of the previous phenomenon.

It is an interesting fact also, that the interval between the two storms was exactly 27 days, or about the period taken by the sun to complete its axial revolution. This same periodicity has been observed in connection with previous storms, which fact affords further striking illustration of the relationship existing between sun spots and recurring earth current phenomena.

The storm of Friday last gave evidence of its approach as early as 8 A. M. on land lines, and prior to that on submarine circuits, but did not develop to serious proportions until about 12:30 P. M. At 1 P. M. most of the wires were practically useless and continued so until about 2:15 P. M.

After that time there were intervals of quiescence from the disturbing forces, during which it was possible to dispose of some of the rapidly accumulating business.

During the height of the storm the forces would sometimes violently fluctuate from one polarity to the opposite, but more frequently the variations occurred with great deliberation and without changing their direction while the galvanometer needle would often remain stationary at some particular point for several seconds at a time.

Fig. 1 shows a graphical representation of the fluctuations of the earth currents taken by the writer on a western wire, 481 miles in length, between 1:45 P. M. and 1:48 P. M., which was probably the period of greatest intensity. The highest value attained during that time was 285.4 milliampères, equivalent to a difference of potential between the distant grounds of 650.71 volts, or about four times the strength of the voltage regularly employed on that circuit. This is the highest pressure ever recorded at natural currents.

Some milliammeter measurements taken in Buffalo between 1:40 P. M. and 2:07 P. M. on a New York wire show a range in the current strength of from 50 to 240 milliampères, the latter value being recorded at 2:01 P. M., the difference of potential between the two grounds at that time approximating 500 volts.

Advices from Chicago state that on wires between that point and Cleveland, Kansas City, St. Paul and Memphis, and on several circuits extending in various directions, but connected together so as to enable Chicago to come in circuit as an intermediate office, the electromotive forces varied from 50 to upward of 340 volts.

The greatest differences of potential, as a rule, were noted on the longer circuits. For instance, at 2:10 P. M. a wire to Newark, N. J., about 10 miles in length, and in which the current strength was 95 milliampères, showed a potential difference between the opposite grounds of 19 volts only.

A New York-Philadelphia wire 91 miles long, with a current of 26 milliampères traversing it at 1:55 P. M., exhibited a pressure of 39 volts.

A No. 8 gauge iron wire between Richmond, Va., and Norfolk, whose grounds were 104 miles apart, furnished a current of 30 milliampères under a pressure of 86 volts at 1:30 P. M.

A current of 40 milliampères was developed in a wire from New York to Olean over one of the postal telegraph lines 400 miles in length at about 3:45 P. M., the E. M. F. equivalent of which was about 91.5 volts.

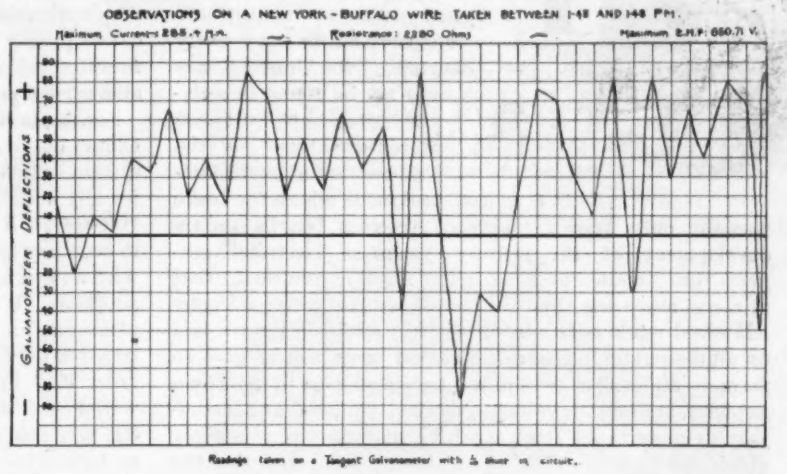

OBSERVATIONS ON A NEW YORK - BUFFALO WIRE TAKEN BETWEEN 1:48 AND 1:48 P.M.
Maximum Current: 285.4 M.A.
Resistance: 2280 Ohms
Maximum E.M.F. 650.71 V.
GALVANOMETER DEFLECTIONS
+
-
Readings taken on a Tangent Galvanometer with ½ shunt in circuit.

FIG. 1.—FLUCTUATION OF EARTH CURRENTS IN TELEGRAPH LINES.

The electrical pressure observed at 1:05 P. M. in a 413 mile circuit between New York and Lynchburg, Va., was about 112 volts.

No *simultaneous* readings, however, were obtained from wires on different routes, so that a proper comparison of the energy developed in the various circuits at any given time cannot be instituted.

The disturbance practically ceased about 5 P. M., and in this respect the recent storm differed from the preceding one, which was of much longer duration.

An idea of the powerful influence exerted upon magnetic needles by the *direct* inductive action of the currents flowing in the ground at such times may be judged from the following circumstance: A New York electrician who was endeavoring to take the "constant" of his galvanometer in Seymour, Conn., about 1:30 P. M., with the view of making some practical tests there, was unable for a time to do so owing to the deviations of the needle for which he could not then account. These variations extended over about 40 divisions of the scale on either side of the zero point, although the coils of the apparatus were entirely disconnected from the ground and its needle subject to a directing influence from permanent magnets. It was only by entirely overcoming the effects of the earth currents by means of the controlling magnets that he finally succeeded in accomplishing his purpose.

Many other curious and interesting results were noted which may form the subject of a supplementary article.

The Mt. Washington Search Light.

The great search light on Mt. Washington, which has been regarded more as a myth than a reality, has at last materialized. It was tested on last Saturday evening, and the results were very satisfactory. It is reported that coarse print could be read at the Fabyan House, seven miles distant, when the light was flashed that way.

This light was designed by Mr. Lewis H. Rogers, of the Thomson-Houston Electric Company, who had made a special study of search lights, and was anxious to see what they could do at such high atmospheric levels. With the co-operation of the various railroads and hotels the plant was erected at a cost of $7,000. A tower 55 feet in height was built on the highest peak of the mountain, so that the light is fully 25 feet higher than the ridge pole of the hotel. The light was made by the Thomson-Houston Company. The tower is braced at every corner with a steel cable—a very necessary precaution against the gales which sometimes blow at a rate of 186 miles an hour. The projector stands out on the topmost part of the tower, but the operator controls the movement of the light by means of electric motors from a glass-inclosed room below. In the glass-inclosed room there is also a six-foot telescope, with a five-inch lens. The current for the light is generated in the basement of the tower by a 100 ampère dynamo, driven by a 15-h. p. engine. The power of the light at the lamp itself is 20,000 candles, but when projected into space from a French Mangin lens, 30 inches in diameter, it is increased to 100,000 candles

Electrical Investments in Country Districts.

BY WILLIAM NELSON BLACK.

IN a preceding article on the application of electricity to agricultural operations and public highways it was held that the proper way to obtain a good means of transit and transportation in the country districts of the United States would not be found in a servile imitation of European precedents made by the construction of macadamized roads where the horse was the only known means of traction, but in such a development of the railway system as electrical progress has made possible. It was maintained that at a cost much less than the cost of constructing good macadamized roads railways for electric service could be laid on all the public highways, and that they would give to farmers a means of transit and transportation in their own vehicles, or in public vehicles, more economical and incomparably more rapid than anything that they can possibly obtain through horse traction. It was seen, too, that the construction and operation of such roads would open the way for the use of the electric motor in almost all farm labor now done by horses, and in much labor done by hand. It remains now to consider the subject from the investors' point of view, and to see what forces may be found at work or set at work for promoting the desired system, and making it profitable as well as convenient.

Of course the chief beneficiaries of electric roads on all the highways of the rural districts must be the farmers themselves; and, except in a few densely populated counties having entirely level grades and considerable villages, there would not seem to be, at first thought, a sufficient certainty of dividends to justify merely speculative promoters of electric roads in assuming all the risks of their construction. The travel over such roads could not ordinarily be very large, and the transportation of farm products would be limited to certain short seasons. It will seem, therefore, that the farmer himself should be prepared to stand behind any movement directed toward facilitating his means of communication through the agency of electricity, and be willing to give as much material assistance as the undertaking would require. All, and more than all, that he would risk would be returned to him in the greater economy of his farming operations, in his greater comfort, and in the increased value of his lands. Nevertheless, there are several reasons for thinking that he would not be left alone in his labor of yoking electricity to his road wagon and plow. It is a fair presumption, indeed, that the prospective value of the stock would soon give him the co-operation of some of the heaviest capitalists. It would certainly give him the co-operation of some of the heaviest industrial operators. Let us look at some of the causes that give even a gilt edged appearance to the plan for introducing electricity into the rural districts.

First, we live in a country that is increasing with wonderful rapidity in population. But under prevailing conditions the increase either goes to the cities, or is distributed through new farming districts that tend rather to the injury than to the benefit of the older farming sections. The country has been doubling its population in periods of about 25 years; and we have no reason to think that the ratio will decline during the next 25 years. We have more reason to think that, if no mismanaged party strikes a fatal blow at our prosperity by the introduction of revolutionary measures for the restriction of enterprise, the ratio will increase, and that the country will have more than 130,000,000 inhabitants at the end of the next 25 years. Is there nothing in this prospect suggestive of great possible profit in the introduction of electricity in the rural districts and the promotion of a universal system of rapid transit?

It was said that the increase in population had been heretofore either concentrated in the cities or distributed over new farming sections. But why has this been true? Mainly because the rural towns and villages have remained inaccessible. They have been like little eddies on the borders of a swift current, unobserved, and generally unknown, and, together with the farming districts by which they are surrounded, they have remained nearly stationary in population, while the cities have grown enormously. Yet those villages in many cases would offer great advantages for the prosecution of a large variety of industries that now seek the cities, but which would quickly be removed to the country were there any means of conveying coal and other manufacturers' supplies cheaply to the ground where they would be needed. Observe how quickly the small hamlet that happens to lie upon the line of a steam railway begins to wear the aspect of a considerable town after the completion of the road. With a general system of electric railways the villages everywhere would go through the same transformation. The high rents and costly living expenses of cities would send thousands of manufacturers to the country could their work be done there without a loss equal to the gain; and, as a consequence, we could expect to see a more healthful distribution of the increase of population in the future than we have seen in the past. The great cities would grow less rapidly, but, built up with greater solidity and care, they would find improved sanitary conditions, and the country districts would enter upon a career of unparalleled prosperity. The effect of this transition on the success of the electric highways will be readily apparent. Within ten years after they were opened in any district it would probably be found that their income had doubled, and this, of course, would greatly enhance the value of their stock. Incidentally, too, the farmers would be benefited again in their agricultural operations. They would find their incomes greatly increased by the enlargement within a few minutes' ride of their homes of the market for their profitable garden products.

Let us pursue the subject along these lines and see if we cannot discover a promise of direct profit in the proposed system sufficient to make it a good field for investment for any investor, even when immediate returns are desired. Heretofore it has been considered mainly with reference to economy in the prosecution of farming operations, and with an eye to the public benefits that would follow on its adoption. We have seen that the farmer's labor would be pleasanter and more profitable after he had trained electricity into his service, and that the system would gain a great deal in the end through the readjustment that it would cause in population and industry. Enough certainly has been said for the encouragement of the farmer, and if he fails to become an enthusiast in favor of the improvement after all that has been urged in its behalf, it must be because the wheels of his wagon have become immovably fixed in some almost bottomless rut. Then let us take leave of the farmer and the social philosopher for the moment and look up some of the "monopolists."

The first men of the kind whom we discover are the manufacturers of electrical machinery. Given a system of electrical highways in the country, with electrical machinery on the farms, and it would be difficult to estimate the enormous expansion that electrical machinery must directly receive. It is common to say that the electrical industry is only in its infancy. Considering its beginnings, it may be conceded that it has already grown to startling proportions; but when the use of electricity has grown to be general in the rural districts, it will directly become the chief industry of the country. Electrical manufacturers should not need much prompting, therefore, to lead them to become not only the co-operators but promoters in the enterprise of providing a system of electrical highways. They would be justified in undertaking the construction of a million miles or so of such roads on their own account, only providing that they could find the capital.

But electrical manufacturers are not railway builders, and it may be thought that they do not represent the kind of "monopolists" that we should find. But neither is it exclusively a railway enterprise that is advocated. It is simply the universal distribution of electrical power, and the construction of the railway will be only an incident. The equipment and operation of the service will be the chief things to consider, and at this work we shall find the electrical manufacturer a very important personage, the most important personage in the world. Let us see how electrical companies organized with the proposed objects in view would probably find it necessary to operate in the beginning, and in this study we shall be able to see who next after the farmer would be the proper men to move.

Our farmers are not rich men as the world goes. If we take them at their own assessment in the newer States they are excruciatingly poor; and in the older States they are only solid men who have little to expend in luxuries. They possess everywhere their own farm equipment, too, which the introduction of electrical machinery would tend to render worthless. With the electric railway on the roads and the electric motor on the farms, their road wagons, top buggies, carriages, horses and single plows would become useless, and they would have to give way to the electric vehicle and gang plow. Then, again, the electric motor itself is not inexpensive, and every farmer would have to be provided with more than one of these, varying in horse power to perform the different kinds of work demanded. His road vehicle must be provided with its own independent motor, and the motor used for plowing and threshing would be needlessly heavy for the lighter service of the dairy or farm house. Very few farmers, therefore, would be able to provide themselves from their own accumulated resources with all the electrical equipment and new farm implements that would be required. Mortgages on their equipment might, of course, be made to do duty; but even mortgages might not always offer the best expedient.

More of the electrical machinery and much of the agricultural machinery, such as threshing machinery, would have to be owned by the companies, and it could be held in company hands and leased on terms that would make its use economical to the farmers and profitable to the companies. It might be necessary even for the companies to own a sufficient number of gang plows to break up the lands of those farmers who felt themselves unequal to the expenditure of money enough to give them possession of their implements. All this would be a large source of income to the companies.

Then, again, there would be another large source of income in the sale of electric light and manufacturing power. All the rural villages, as well as the country highways and farm houses, could be lighted by electricity, and the profits on the sale of light alone would be very large. Most of the electric motors—nearly all, indeed, except those running on the highways, would stop running before twilight, and then the power of the central station could be turned to the illumination of the district that it served at very low cost. The amount of power, too, that would be demanded for the manufacturing operations of the rural villages, large in the beginning, would be a constantly increasing quantity, until it finally became one of the chief sources of profit.

Looking at the subject from these points of view, it becomes broadly a question of investment, and one is disposed to inquire if any company, whether composed mainly of farmers or not, could not prudently select its territory and proceed with the work of preparing the plant and selling electrical power for use in rural transportation and agricultural operations. There will be many to believe that it would be entirely prudent, and there will be not a few, among whom the writer must now confess his willingness to be numbered, who will think it the best field for large or small investments to be found. To the farmer and to the electrical manufacturer there should be no question as to its advantages. It can enrich them both where they are not already rich, and to those who are already wealthy it can bring much additional income.

Will it be necessary to urge this subject on the attention of farmers? One would think not. One would suppose that the bare suggestion that they can be enabled to ride 15 or 20 miles an hour in vehicles under their own exclusive control, and see 12 acre fields plowed, harrowed and seeded in a few hours, and that they can save money by the operation, would be enough to make them lie awake nights working out the problem. It will certainly not be necessary to urge the subject on the attention of the electrical or iron manufacturers. Those gentlemen will be willing.

It will be safe to assume that nobody will need much urging, and we have only to inquire how the system should be organized. Of course we need men at the head who understand the meaning of railway stocks and bonds, and too many of our farmers, bound to the plow, never seem to have carried their financial studies beyond the rudimentary elements of farm mortgages. But they should learn to comprehend more fully the basis of financial enterprises, and have their industrial sympathies enlarged. Much injury has come to the country through the prolonged battle between the farmers and the railroads, and it is time that they owned some railways of their own in order that they may be enabled to comprehend their financial mechanism. The writer is inclined to think, therefore, that the introduction of electricity in the rural districts should be engineered through the farmers, and that they should be urged to hold a large if not a controlling interest in the stock. True, the tendency toward concentration in all ventures cannot be prevented. As you can lead a horse to the water, but cannot compel him to drink, so, also, can you sell a man stock, but cannot compel him to hold it. But if the farmers are financially interested in this matter from the beginning it should go better and with greater expedition. We have more than 160,000 miles of railway in the country now. We should have more than a million miles at the end of the current decade if the productive resources of the country are equal to their construction and equipment. We should have even a larger total mileage than this were all the men who would be directly interested in their construction led to actively co-operate.

Let us have the argument summarized under a few numerical heads:

1. The travel and transportation on the railways themselves will pay, or very nearly pay, the interest on the bonds required in their construction.

2. The rental on electric machinery, while enabling the farmers to save money on their farm labor, will be a source of large profit to the electrical companies.

3. The profits on the sale of electric light and power to rural villages and manufacturers will very largely add, not only to gross income, but to net returns in the form of distributed dividends.

4. The telephone service will eventually become a large source of additional profit.

A Primary Battery Competition.

We have received the following letter from Mr. Converse D. Marsh, suggesting a possible method of ascertaining the merits of various primary batteries: "In view of the many claims made by different inventors of primary batteries, and in order that an opportunity for demonstrations be afforded those who have faith in their own assertions, would not the idea of a primary battery competition under the auspices of THE ELECTRICAL WORLD claim universal interest by reason of the inherent matter for discussion in the subject itself, and the recognized standing of that paper.

"If the suggestion is in order I would propose that each competitor furnish three cells of a definite standard in size; these cells to be tested for constancy of electromotive force at rated discharges, capacity in watt hours, intermittent maximum discharges with volt and ampère readings and amount of local action on open circuit; the award to be made to the battery scoring the highest average of points.

"Such a determination would furnish detailed, authentic information for the trade and the public, and for this purpose it would afford me pleasure to serve both by entering the 'Kolon' primary battery in such a competition."

A Westinghouse Plant in Brazil.

The plant of the Companhia Mineira de Electricidade of Juiz de Fora presents some interesting features, not only on account of its being the only Westinghouse installation in Brazil, but from its natural situation and the difficulties of construction. Juiz de Fora is situated in the province of Minas Geraes, and is about 180 miles northwest of Rio Janeiro, in the mountain.

In 1888 the local company began negotiations with the Westinghouse Electric Company for the installation of an alternating electric light plant. The contract was secured by the Marr Construction Company, which at that time was affiliated with the Westinghouse company, and the first shipment of material and appliances was made in the winter of 1888-1889. The first outfit consisted of one special 26½ inch double discharge Leffel mining wheel, two No. 1

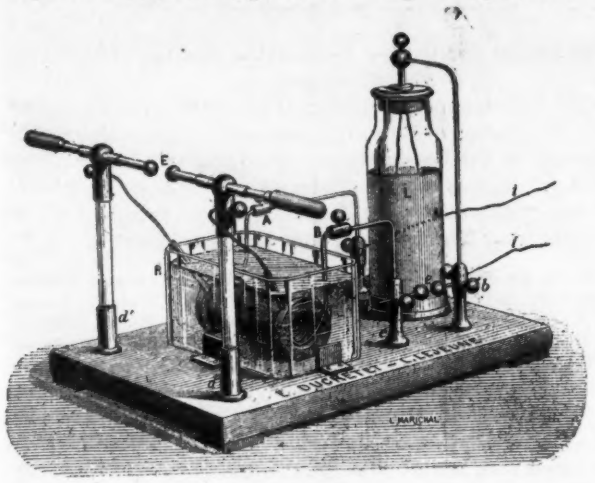


FIG. 1.

A. C. dynamos, converters and switchboard appliances, together with the necessary belting, etc. Line material sufficient for the first needs of the plant was forwarded, and also an ample supply of inside wiring material and appliances for incandescent street lighting. Two engineers were sent soon after the shipment of the goods and in due time the plant was installed and put in operation. Subsequently the same company sent a third No. 1 dynamo, and to-day there is in operation in Juiz de Fora 212 street lamps of 32 c. p., and 950 16-c. p. lamps in shops, residences, etc.

Another wheel now supplements the power plant, and its present capacity is 300 h. p. A fourth dynamo of 750 light capacity is about to be added, which will be used for interior lighting.

Unusual difficulties had to be surmounted in installing this plant. The engineers, being unfamiliar with the Portuguese language, found great difficulty in communicating with their laborers; skilled assistance in any mechanical department was wanting; tools and ordinary appliances such as could be found in almost any small community in this country were not available. The negroes, who are the laborers of the country, were found to be lazy and inefficient.

No suitable material for poles could be had among the native woods. The station is by bridle path some six miles from the centre of lighting, and the line is run over the hills and through valleys, thick woods and jungles, three and a half miles in a straight line. The conductors are erected on iron railroad rails. These poles, or rails, are set five feet in the ground and the cross-arms bolted to them. Throughout the town yellow pine poles are used, which were sent out from America.

In the early operation of the plant very great loss and inconvenience resulted from the terrific thunderstorms which prevail in the mountainous country of Brazil. The damage to station material was very great, and the interruptions were occasionally awkward and expensive. There are now erected at various points on the line 20 pairs of lightning arresters. In the station there are two to each circuit. Within the last year, and since the present equipment of lightning arresters was installed, no interruptions have occurred in the operation of the plant, although electrical storms of a disastrous nature have been common during the summer months, which correspond to the winter months in this country.

The two engineers originally sent to Brazil by the Marr Construction Company returned in July, 1891. In August of the same year Mr. D. S. Van Wagenen sailed to take charge of the plant. Mr. Van Wagenen has made very many improvements and additions to the plant. He is in this country now on business for the company, but proposes to return in October. He has great confidence in the prospects of electric lighting in Brazil.

Currents of High Tension and Great Frequency.

The following description, taken from the *Bulletin de la Societè Belge d'Electriciens*, of apparatus constructed by E. Ducrett and L. Lejeune, of Paris, for the purpose of performing the experiments of Thomson and Tesla with currents of high tension and great frequency, is of considerable interest and shows how many of the brilliant effects can be produced by comparatively simple means.

Fig. 1 represents the whole of the apparatus necessary to repeat the experiments in question, except, however, the Ruhmkorff coil shown in Fig. 3. The whole of the apparatus is mounted on a single base, and in order to complete the installation it is only necessary to connect the wires *i i* of the induced circuit from the coil to the wires *i i*, shown in Fig. 1.

The Ruhmkorff coil is operated by the current of five or six accumulators. The induced current from this coil is used to charge a Leyden jar *L*, and this jar produces at *e*, in the form of very rapid sparks, the length of which can be varied by separating or bringing together the knobs, oscillating discharges which have the effect of considerably increasing the frequency of the induced currents produced by the coil.

In the discharge circuit of the jar is inserted the primary wire of a transformer *T*, completely immersed in oil, which

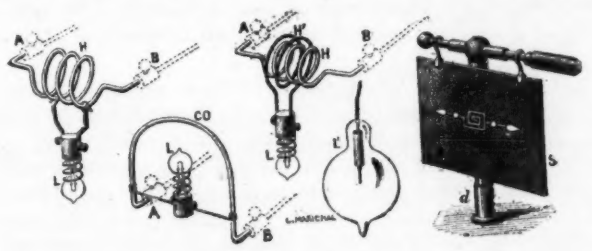


FIG. 2.

insulates it, and the secondary wires are led to the sparks terminals *E*. The two wires of the transformer are separated by an ebonite tube.

At *e*, and for an apparatus of greater dimensions in which the Ruhmkorff coil is replaced by an alternator operating a transformer, there can be added to the apparatus either a blast pipe, which blows air upon the spark, or a jet of carbolic acid thrown from a jar which contains this gas under pressure, or even an electromagnet, the poles of which are at right angles to the spark. It is well, in this last case, to cover the pole pieces with sheets of mica, in order to prevent the spark from jumping across to them. It is this last method which d'Arsonval employs; the sparks at *E* are then much stronger, and the effects obtained are considerably increased.

Physiological Effects.—The spark at *E* can attain four centimetres in length; even in these conditions one can hold in each hand one of the spark terminals, especially if the following precautions are taken: The two knobs being in contact, seize one in each hand and separate them; when the experiment is finished bring them together in contact with each other before letting go. Under these conditions the operation should not cause any trouble, whatever may be the coil employed or the length of the spark at *E*. D'Arsonval has made the most complete study of these effects.

Luminous Effects.—Detach the conductors which connect the transformer *T* to the exciter *E*; if the experiment room is sufficiently dark the conductors will be seen to light up, brushes will shoot forth, light bodies will be attracted, and the odor of ozone will be clearly detected. These phenomena are then of exactly the same kind as those which Holtz and Wimshurst machines produce, and in every respect they are comparable to the phenomena of static electricity.

Take a glass tube in which the proper partial vacuum has been made. Taking in the hand one end of this tube, bring the other end in contact with one of the spark terminals; the tube will be seen to light up.

The human body can itself serve as a conductor in this case. Holding in one hand the end of a Geissler tube and seizing with the other one of the spark terminals, the two knobs being separated, if another person should now come and take hold of the free end of the tube it immediately

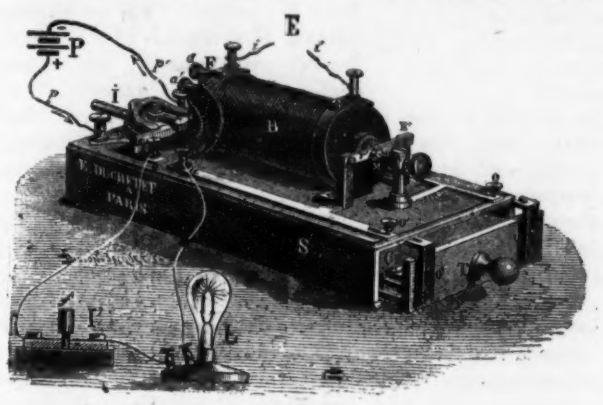


FIG. 3.

becomes very luminous throughout its length. A chain of persons can thus be formed holding between them tubes which light up under the electric influence.

The tube can also be illuminated without putting it in immediate communication with the exciter. For that purpose a metallic surface *S* (Fig. 2) is suspended at one of the spark terminals and an electrostatic field is thus created, which extends some distance. A Geissler or Crookes tube held in the hand by one end is illuminated in the neighborhood of the plate without having any immediate contact with it.

Another phenomenon equally interesting is this: Suspend at one of the spark terminals *E* a lamp *L* (Fig. 2) with a single electrode, or even without an electrode, and it will light up and there will be produced, particularly if the hand is approached, a brilliant discharge in the form of a brush, constituting a most remarkable phenomenon. The brush is displaced with the greatest ease, under the influence of the weakest magnetic variation. Mr. Tesla, moreover, believed he saw in this phenomenon at the time a new mode of lighting, and perhaps also a means of telegraphing at any speed whatever across the Atlantic.

Miscellaneous Experiments.—The oil vat *R* (Fig. 1) is raised as well as the transformer *T*, which it contains. The two terminal wires *A* and *B* left free are attached to the ends of a large wire *CO* of short length, the resistance of which is almost nil (.0007 ohm). An incandescent lamp *L* connected to the two ends of this large wire comes to a white heat. The lamp being of four volts, the calculation shows that to obtain the same effect with a continuous current the intensity of the current passing in the large wire ought to be about 6,000 ampères.

By substituting for the large wire *CO* a solenoid of ten spires *H*, it is possible to light the lamps *L* of different voltages (Fig. 2) by carrying the two wires of these lamps to different points of the solenoid; an interval of two spires suffices for a lamp of four volts.

Lighting by Induction.—An incandescent lamp *L* (Fig. 2) of four volts connected to the two ends of a solenoid H^1, of two spires, comes to a white incandescence when the large solenoid *H* is placed within the other and the discharge made through it.

FIG. 1.—BRAZILIAN CENTRAL STATION.

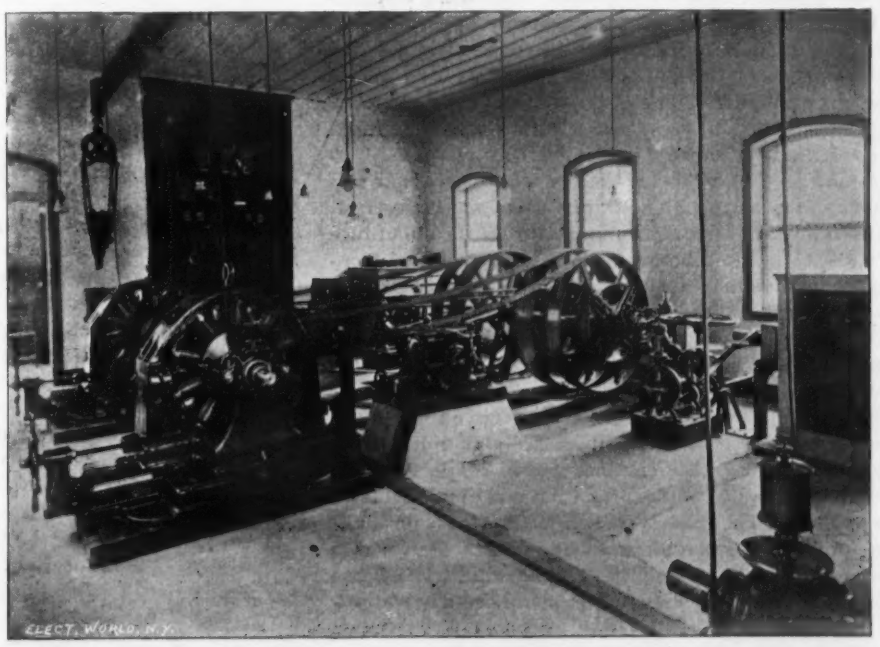


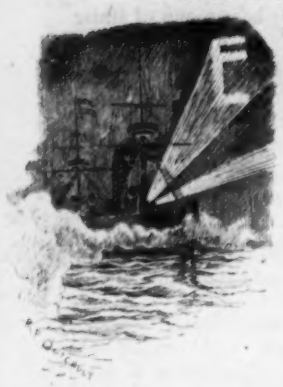
FIG. 2.—BRAZILIAN CENTRAL STATION.

On the Applications of Electricity in the Royal Dockyards and Navy.—II.*

BY HENRY E. DEADMAN.

Chief Constructor, Portsmouth Dockyard.

2.—INCANDESCENT OR GLOW LAMP LIGHTING.



ELECTRICITY is at the present day largely resorted to for the purpose of lighting internally the vessels of the navy; all the larger vessels, such as battle ships and first and second class cruisers are now so lighted. Moreover, this mode of lighting is not restricted to the habitable portions of the ship, but is carried out to the complete exclusion of other modes, although the latter may be fitted as a reserve. Thus the electric lighting is extended to machinery spaces, coal bunkers, magazines, shell rooms, gun quarters, etc., as well as to the illumination of compass cards, telegraph dials, bow and mast head and signal lanterns, semaphores, etc. Clusters of glow lamps beneath an enameled metal reflector are also employed for lighting the upper deck, when coaling or other operations are being carried on at night. In a large battle ship like the Royal Sovereign there would be about 800 of these glow lamps, necessitating for this system alone about 8 miles of electric leads, which are equivalent to something like 155 miles of copper wire of varying sizes, principally No. 20 legal standard wire gauge or 0.036 inch diameter.

Progress.—The first installation of internal lighting in the navy was carried out on board the Inflexible in 1881 by the Anglo-American Brush Company. It was a combined system of arc and glow lamps. The dynamos used were of the Brush type, of which the first specimen brought to this country was purchased by the Admiralty, and is still in use in Portsmouth dockyard. Each machine was capable of maintaining 16 Brush arc lamps of 2,000 c. p. each. The lamps had double sets of carbons, each pair burning eight hours. These arc lamps were switched on and off by a switch opening and closing a shunt circuit of small resistance. With this plan it is evident a lamp could not be safely handled while the current was on, even if the light was switched off, because the lamp itself still formed part of the circuit. A switch was accordingly devised in the dockyard, by means of which the lamp could be cut completely out of the circuit. The Swan glow lamps were fitted in sets of 18 in series, each set being placed in parallel between the main circuits of the arc lamps. Each glow lamp was fitted with an automatic cut-out, bringing into the circuit a resistance equal to about that of the lamp, in case the latter failed. This system now no longer exists in the Inflexible, an installation on modern methods having been substituted for it.

The five Indian troopships were next fitted throughout with glow lamps by the Edison company, which used the Edison Hopkinson type of dynamo, giving a current of 180 ampères at 110 volts. The Polyphemus was also entirely fitted by Messrs. Siemens, and the Colossus by the Brush company, the dynamos in the latter being of the Victoria Brush type. The Polyphemus was the only ship in the navy fitted on the single wire system. Afterward the adoption of internal lighting became general; all new vessels except the smaller cruisers were fitted, as were also the previous vessels on the first opportunity of their coming in for repairs and refit. There are now in the navy about 300 vessels either fitted or being fitted with electric lighting, for search lights or internal lighting or both.

Difficulties.—The earlier installations, although quite satisfactory so far as the illuminating effect was concerned, were certainly not satisfactory in regard to the endurance of the plant; in fact, they were a constant source of trouble, both the dynamos and the leads requiring frequent repairs or renewals. These troubles arose partly from faulty constructions, and partly from the conditions necessarily existing on board ships of war, such as the necessity for placing the dynamos well down in the ship, and under protection from shot, which relegated them either to the engine room, with its high temperature and moist atmosphere, or to some other confined and ill ventilated spot. Under these conditions the insulation soon suffered, and the machine quickly got out of action. The leads throughout the ship suffered too from access of salt water, which caused much trouble by destroying the insulation and producing short circuiting, thereby frequently setting on fire the wood casing in which the leads were laid, or any other inflammable material in the neighborhood.

Remedies.—Nearly all these difficulties have in the course of time been surmounted. While it is still necessary to place dynamos under protection for use in action, it has now become the practice to fit an additional dynamo, capable of running all the lights generally required at one time, and to place it with its motor in an open space between decks, or on the upper deck suitably sheltered. This is known as the peace or daylight dynamo. The introduction of lead-coated wires marked an epoch in ship lighting, and these wires are entirely used in all the later installations, and are taking the place of the old leads as fast as the latter require renewal. These cables dispense entirely with the wood casings previously used, resulting in greater simplicity of fitting as well as increased efficiency. The wood casings are still used in America, even with the lead-coated cables; but in the writer's opinion, while adding largely to the cost of the installation, they are likely to detract from its efficiency, as they form such convenient receptacles for water to lodge in.

Dynamos.—The Admiralty have not adhered to any one particular kind of dynamo; for, although those of the Siemens type predominate in the navy at present, nearly all the well known makers are represented, such as Latimer Clark, Muirhead & Co., the Electric Construction Corporation, the Silvertown India-Rubber Company, Goolden & Co., Crompton & Co., and Parsons & Co. The experience gained in the testing and use of these machines of different types was of immense benefit in enabling those points to be discovered in which dynamos are most likely to fail, and in suggesting the direction which improvements should take. The weak points in most of the machines supplied were imperfect insulation, owing to want of sufficient care in building, and the excessive internal heating of the armature. In some cases the section of copper used was too small, resulting in the heating of the dynamo and the rapid destruction of the insulation. By direction of the Admiralty a design was prepared by Mr. Lane, electrician of Portsmouth dockyard, for a machine to give an output of 400 ampères at 80 volts, which should embody the experience already gained, and should be free from the faults previously mentioned. Five machines have been built from this design, two of them for the Rupert, a vessel now under reconstruction. No opportunity has yet occurred for testing them under the conditions of sea service; but two have been used for about a year under full load, as temporary lighting plant for ships building, etc. At times, too, they have been worked for long periods above full load, from 420 to 430 ampères; and they have always given perfect satisfaction. They are driven at about 33 revolutions a minute by open vertical compound engines of 56 i. h. p., designed and constructed in the chief engineer's department of the dockyard. The total weight of the dynamo and engine with bedplate is about 5½ tons.

Other Fittings.—As regards the other fittings required to complete a successful installation—such as switches, fusible cut-outs, lamp-holders, shades and their holders, etc.—patterns have been adopted or devised in accordance with accumulated experience, to meet the special requirements of the navy: these are simplicity, combined with strength to withstand the rough usage necessarily experienced on board a fighting ship. The guiding principle in the present installations is to make every part of the circuit inaccessible to water, by employing lead-coated cables, and by inclosing in metallic water-tight boxes all the principal switches and cut-outs, and by effecting in all cases in the interior of water-tight distributing boxes the subdivision of the mains, which themselves pass into the boxes and their subdivisions out of the boxes through water-tight stuffing glands.

Switchboard.—With several dynamos and a combined installation of incandescent and search lighting, a good switchboard is a necessity. The one generally used in the navy at present is susceptible of improvement, and a new switchboard has just been designed and made by Mr. Lane, the dockyard electrician, which promises to fulfil all the requirements.

Temporary Installations.—The employment of temporary installations of electric lighting in ships building and repairing has been a marked feature of recent practice in Portsmouth dockyard. Probably more has been done here in this respect than has been attempted in any other royal dockyard or private shipbuilding yard in the country, although these are now finding it to their advantage to follow the lead. So highly satisfactory have been the results of the experiments in this direction, that, with the exception only of the smallest ships, the electric light is now installed as a matter of course on board every new vessel at an early stage of its construction, and also in all vessels where repairs of any magnitude are to be carried out. The character of these temporary installations varies with the circumstances of each case. Where vessels are building in the docks adjacent to the electric shop, it is, of course, more convenient and economical to supply the current from a dynamo in the shop itself, the leads being carried to the ship on temporary wooden poles put up for the purpose. Vessels building on the slips, which are too far from the electric shop to convey the current to them in an economical manner, are served by a dynamo and motor placed at some convenient spot near the ship. After a vessel is launched, and generally for all vessels afloat, the most satisfactory method is to place a dynamo and engine with a steam boiler in the ship itself, generally in a temporary wooden house on the upper deck. By this means the light is maintained without interruption during the many movements of the vessel about the basins. The leads, lamps, etc., are fitted roughly. The cables are simply tied to clips fastened to the beams, etc. The switches are hung from the cables. The lamps with their holders are secured to wooden bases, and protected by wire guards without any glass globes.

Cost.—Although no exact comparison can be given between the cost of this mode of illumination and that of the old plan of lighting by candles, it is estimated that in a first-class cruiser like the Royal Arthur the total cost of the electric lighting during the whole period of building, including depreciation of plant, would be about £1,200. This would probably not much exceed, if at all, the cost of candles for the same period; but the vastly superior illumination obtained by the electric light—enabling work to be done better, more quickly and under better supervision, to say nothing of the advantages in health and comfort to the workmen—would justify the continuance of this system, even though the actual cost should be much greater than that of lighting by candles. It is hardly an exaggeration to say that the excellent results as regards celerity and cheapness of construction, which have lately been attained in Portsmouth dockyard, could scarcely have been realized without the aid of the admirable illumination afforded by the system of incandescent lighting.

*A paper read before the Institution of Mechanical Engineers at Portsmouth, England. For the first section see THE ELECTRICAL WORLD of Aug. 13, 1892.

The Edison Companies' Association Meeting at Toronto.

The eighth annual meeting (Thirteenth Convention) of the Association of Edison Illuminating Companies met in Toronto, at the Rossin House, on Tuesday, Aug. 9. The first session was called to order at 2:30 o'clock by John I. Beggs, who has been for the past six years president of the association. The following members were present:

W. M. Brock, Paterson, N. J.; A. F. Walker, Grand Rapids, Mich.; W. S. Barstow, Brooklyn, N. Y.; Wilson S. Howell, Orange, N. J.; Frederick Nicholls, Toronto, Canada; C. L. Edgar, Boston; J. H. Vail, New York; J. A. Colby, Des Moines, Iowa; F. E. Jackson, Harrison, N. J.; W. L. Garrison, Brockton, Mass.; George R Stetson, New Bedford, Mass.; Chas. R. Price, New Bedford, Mass.; Wm D. Marks, Philadelphia, Pa.; J. H. McClement, Amsterdam, N. Y.; Arthur Williams, New York City; Arthur E. Kennelly, Orange, N. J.; A. L. Smith, Appleton, Wis.; Charles Wustenfield, Elgin, Ill.; Hoys Post, Detroit, Mich.; C. P. Gilbert, Detroit, Mich.; E. R. Weeks, Kansas City, Mo.; S. B. Eaton, New York City; G. H. Van Etten, Little Rock, Ark.; J. E. Sayles, New York; Charles H. Lindenberg, Columbus, O.; A. W. Field, Columbus, O.; Samuel Insull, Chicago, Ill.; W. J. Jenks, New York City; George H. Finn, St. Paul, Minn.; Maurice Hoopes, West Chester, Pa.; John I. Beggs, New York; A. D. Page, Harrison, N. J.; John R. Markle, Grand Rapids, Mich.; John Langton, Peterborough, Can.; Henry W. Darling, Newport, R. I.; H. J. Smith, New York; M. D. Barr, Toronto, Ont.; Edwin W. Hammer, New York City; C. R. Van Trump, Wilmington, Del.; W. S. Andrews, Peterborough, Can.

The standing committees of the association were called upon for reports, and from these reports several discussions of practical subjects resulted. These included the importance of high insulation in the interior wiring of buildings and the improvement of safety fuses. On several of these questions the association was favored by a practical talk by Capt. William Brophy, of Boston, who, by vote of the meeting, was specially invited to be present and participate in the discussion.

Mr. J. H. McClement raised some interesting questions relative to the possibilities of operating electric railway systems, and during the discussion Mr. William Lloyd Garrison, of Boston, was called upon, and gave, in an exceedingly interesting manner, some results of his pioneer incandescent electric light experience at Brockton, Mass. Instructive remarks were made by Messrs. Barstow, of Brooklyn, and Mr. Stetson, of New Bedford.

By invitation of the association, Mr. M. J. Sullivan, for several years official stenographer of the association, read a paper entitled "The Central Station and Street Railways," which commanded the close attention of the delegates, and occasioned further discussion on the questions suggested.

An interesting and valuable paper, illustrated by statistical tables and diagrams, was read by Mr. J. H. Vail, on "The Application of New Apparatus and High Economy Engines in Central Stations to Secure Greater Commercial Efficiency and Economy of Coal."

Returning from a delightful drive through the suburbs of the city, in open carriages provided by the Edison company of Toronto, the association convened for the second session at 11 o'clock on the second day. The courtesy of the Edison company in arranging for this early morning ride and the moonlight sail of the previous evening was suitably acknowledged by a vote of the association. The Canadian department of the General Electric Company offered to the delegates the pleasure of an excursion to the Peterborough factories, but as the business engagements of the majority of the members of the association prevented any general attendance upon such an excursion, the invitation was declined with regrets and thanks.

The principal feature of the day's programme was a discussion of important questions of business policy. In the afternoon the discussions of the morning were continued, Mr. C. A. Coffin, president of the General Electric Company, and Mr. S. B. Eaton, general counsel of the Edison Electric Light Company, being present and participating.

The following officers were chosen for the ensuing year: President, John I. Beggs; vice-president, Frederick Nicholls; secretary, W. J. Jenks; treasurer, Wilson S. Howell. Executive committee: C. P. Gilbert, C. L. Edgar, E. R. Weeks, W. D. Marks, Saml. Insull. The question of the place of holding the next annual meeting was left to be decided in future by the Executive Committee.

A statement regarding the work which has been done during the year by the Fuel Gas Committee was made by J. R. Markle. The committee was continued for another year, as were also the committees on lightning protection, on dangers from systems of high pressure, and on grounding the neutral wire.

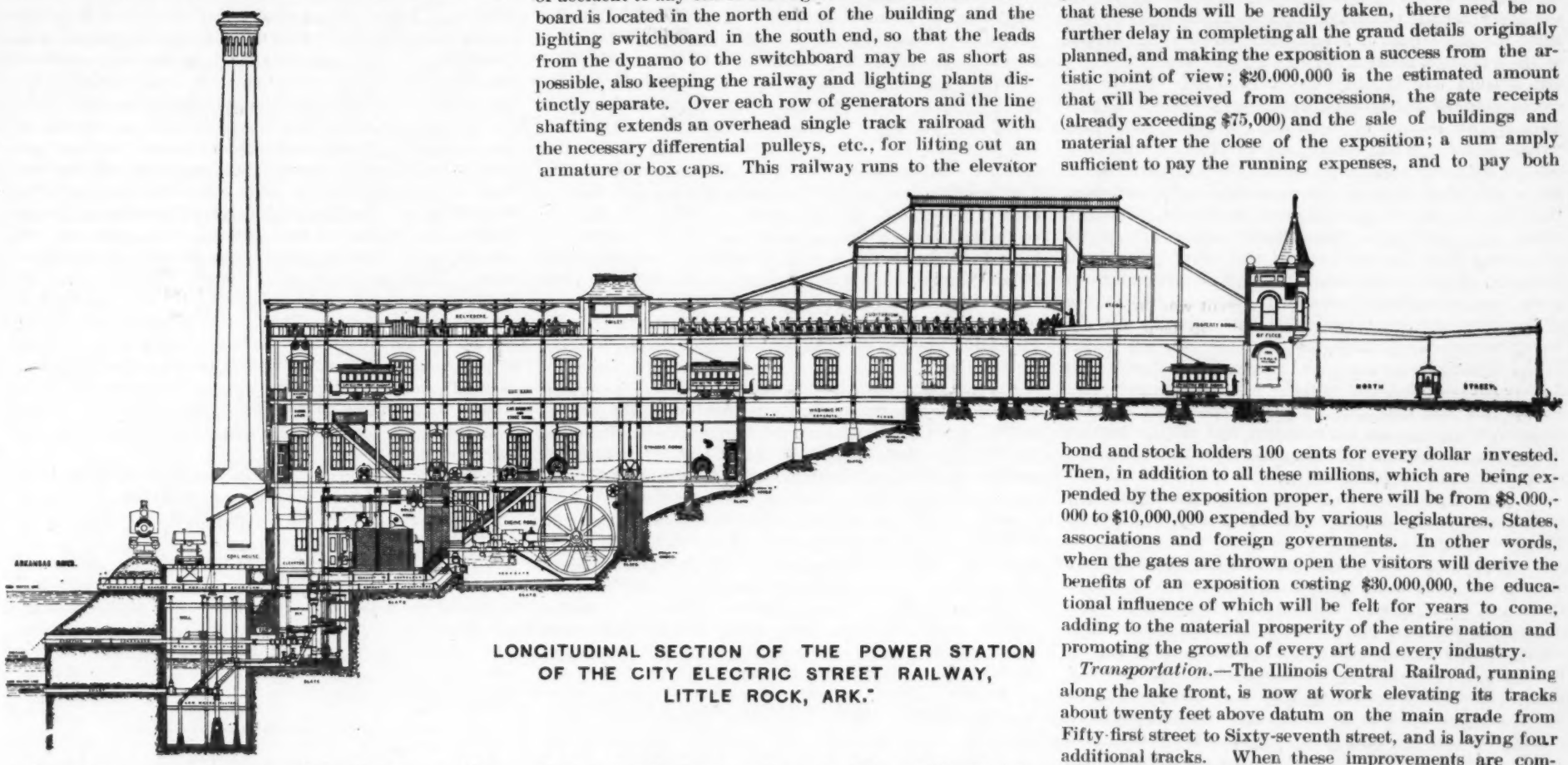
The Electric Railway System of Little Rock, Ark., and Its Operation.

In October, 1891, the Capital Street Railway Company, of Little Rock, Ark., closed a contract with the Thomson-Houston Electric Company to equip the system with electricity. The local company built its own power house, track and roadbed. Mr. H. P. Bradford, general manager of the company, personally superintended the construction of the roadbed and track. The Thomson-Houston Company's contract work, consisting of the overhead construction and the installation of the electrical machinery, was placed in charge of Mr. E. E. Downs, one of the constructing engineers of that company.

The engineering of the power station was placed in charge of Mr. B. J. Arnold, consulting engineer of the Chicago office of the Thomson-Houston Electric Company, who designed the plant and superintended its construction.

The work was pushed rapidly by the heads of the respective departments, and on the 22d day of November, 1891, the trial trip was made in a blinding snow storm without accident or delay of any kind. On the following morning the road was formally and permanently open for traffic, and has operated successfully up to the present date without an accident or delay of any kind attributable to imperfect construction of the power station or the electrical work.

During this period of 131 days that elapsed from the beginning of the construction to the opening of the road, 32 days were lost on account of Sundays and rainy weather, leaving but 99 actual working days. During this time the entire system of about twenty miles of road was either taken up and new rails and ties laid, or the track narrowed from broad to standard gauge, involving the use of about 1,400 poles, 41 miles of No. 0 bare copper wire for trolley and return circuits, and 40,000 feet of No. 000 insulated wire for feeders. At the power station there were 1,000 cubic yards of solid slate excavated, over 1,000,000 brick laid, 330,000 feet of lumber erected on the structure, and 1,000 h. p. of engines, boilers and condensing machinery put in place during this period.



LONGITUDINAL SECTION OF THE POWER STATION OF THE CITY ELECTRIC STREET RAILWAY, LITTLE ROCK, ARK.

The road is now operating twenty 30-h. p. motor cars and six trailers, and is doing it upon 12 tons of slack coal per day of 24 hours' run, or less than one-half ton of slack coal per car per day. The cars operate for 18 hours per day, but the small electric light engine, running 18 arc lights for lighting the car barns and summer theatre, is run all night, and this fuel consumption is included in the above amount. There has been no scientific test made to ascertain the economy of the plant, but these figures were taken from the coal bills themselves showing the actual amount of coal purchased and consumed throughout a period of some months.

These records were taken before the steam piping had been covered by the Chicago Fireproof Covering Company, or the live steam purifiers put in operation, so they do not show as great an economy as the plant is capable of giving.

The power house is located on the Arkansas River. The main line of the St. Louis, Iron Mountain & Southern Railway runs along the river bank in the rear of the building, enabling a side track to be built cheaply and fuel delivered into the coal house with but one handling. Again, being located upon the river at a point midway between Little Rock and Big Rock, overlooking the river for miles in either direction, and the Ozark Mountains on the north and west, it gives the most beautiful view that can be obtained in the city, which resulted in the designer providing for a summer theatre to be placed upon the roof. To those not familiar with the location of this plant, the idea of a theatre on the top of a power station may seem absurd, but when it is remembered that the roof of this building has an area of over six-tenths of an acre, and is located about 100 feet above the river, entirely removed from the noise of the machinery, and giving one of the most beautiful views that can be obtained in the Ozark Mountains, the idea may not seem so peculiar. Again, as the power station is located on the main line of the street railway, the theatre produces a source of revenue to the road that makes it quite an important factor.

The boiler room is 44 by 89 feet by 25 feet high, and in it will be placed, when the plant is completed, eight 250-h. p. Heine water tube boilers. Three of these are at present installed.

The dynamo room is 133 feet long by 88 feet 6 inches wide. In this room will be located two distinct line shafts resting upon the tops of the partition walls of the building. From the north line shaft, which is at present installed, there will be belted eight 110-h. p. Thomson-Houston railway generators, five of which are now in use. There will also be an additional 110-h. p. railway generator belted direct from a high speed engine, located below the engine room, for the operation of the "owl trains" after the main railroad part of the plant is shut down. The other line shaft is located on the top of the wall at the south end of the engine room, and from it will be driven the lighting machinery. The two shafts will be cross connected at their centres with a 54-inch belt, thereby enabling any generator in the house to be driven from any engine in case of accident to any one of the engines. The railroad switchboard is located in the north end of the building and the lighting switchboard in the south end, so that the leads from the dynamo to the switchboard may be as short as possible, also keeping the railway and lighting plants distinctly separate. Over each row of generators and the line shafting extends an overhead single track railroad with the necessary differential pulleys, etc., for lifting out an armature or box caps. This railway runs to the elevator shaft, so that the heavy part may be delivered directly into the elevator and transferred to the machine shop above with but little labor.

There is at present one 1,000-h. p. Smith-Vail duplex condenser installed and two Gordon steam pumps for the boiler feeders, each one of which is capable of supplying the entire plant. Provision is made for an additional 2,000-h. p. condenser.

The shafting now running consists of about 80 feet of 6½ inch hammered iron shafting, with five 62 inch by 15 inch Hill friction clutch pulleys, and the necessary plain pulleys, tighteners and clutches to receive the power from the two large engines now installed. The shaft is divided near the centre so that one portion of it can be kept going in case of a hot journal on either part.

There are at present two main belts in the plant, one of which is 54 inches wide and 135 feet long, the other is 36 inches wide and 125 feet long. These belts transmit the power from the engines to the line shaft. There are five 14-inch belts which transmit the power from the line shafting to the railway generators, all supplied by the Chicago Belting Company. Chapman bronze seated valves are used throughout the entire plant wherever high pressure steam or water comes in contact with them and lighter valves are used on the exhaust connections.

The work was executed by the following contractors: Electrical equipment, Thomson-Houston Electric Company; engines, Hoovens, Owens & Rentschler Co., Hamilton, O.; boilers, Heine Safety Boiler Company, St. Louis, Mo.; shafting, Hill Clutch Works, Cleveland, O.; belting, Chicago Belting Company, Chicago; condensers, Smith, Vail Co., Dayton, O; boiler feed pumps, Gordon Steam Pump Company, Dayton, O.; live steam purifiers, Hoppes Manufacturing Company, Springfield, O.; steam piping, Nick, Poay & Co., Little Rock, Ark., Crane Company, Chicago; steam pipe covering, Chicago Fire Proof Company, Chicago; smoke stack, D. R. Wing & Co., Little Rock, Ark.

Electricity at the World's Fair.

(From Our Own Correspondent.)

CHICAGO, Aug. 13, 1892.

Congressional Action.—Congress having declined to loan $5,000,000 to the exposition and take its chances with other stockholders, with unconscious generosity made an open gift of $2,500,000 in souvenir half dollars, for which a premium of 40 per cent. has already been offered, and added other items making the total appropriation aggregate $3,291,250; while the only condition is the Sunday closing clause. Legislation was also enacted enabling foreign exhibitors to bring over such mechanics and artisans as are required in arranging and caring for their exhibits.

Financial Resources.—It is estimated that the total outlay will be $17,000,000 when the gates are opened and that it will cost about $3,000,000 to conduct the fair during the six months it is open, and to close and disband the different departments. Of the capital stock of $10,000,000 over $6,000,000 has been subscribed and more than $5,000,000 paid in; the city of Chicago has appropriated $5,000,000 as a quasi-subscription, all but $500,000 of which has been paid in; the Congressional souvenirs are valued at $3,500,000, making a total of $14,500,000, paid in or subject to call. The actual expenditures thus far amount to $9,000,000 and there is a cash balance on hand of over $1,000,000. But to secure an amount to finish the work it is now proposed to issue bonds to the extent of $5,000,000, secured by a lien on the gate receipts and paying six per cent. interest; and as there is every indication that these bonds will be readily taken, there need be no further delay in completing all the grand details originally planned, and making the exposition a success from the artistic point of view; $20,000,000 is the estimated amount that will be received from concessions, the gate receipts (already exceeding $75,000) and the sale of buildings and material after the close of the exposition; a sum amply sufficient to pay the running expenses, and to pay both bond and stock holders 100 cents for every dollar invested. Then, in addition to all these millions, which are being expended by the exposition proper, there will be from $8,000,000 to $10,000,000 expended by various legislatures, States, associations and foreign governments. In other words, when the gates are thrown open the visitors will derive the benefits of an exposition costing $30,000,000, the educational influence of which will be felt for years to come, adding to the material prosperity of the entire nation and promoting the growth of every art and every industry.

Transportation.—The Illinois Central Railroad, running along the lake front, is now at work elevating its tracks about twenty feet above datum on the main grade from Fifty-first street to Sixty-seventh street, and is laying four additional tracks. When these improvements are completed the officials believe they can handle 50,000 passengers an hour at the elevated stations along the World's Fair front. To do this they will use eight tracks, with 24 trains an hour, 10 cars seating 60 people each to a train. The other trunk railway lines will use the "Stub" system at the main stations of which there are 36 tracks arranged to hold 36 trains that can deliver or carry away 40,000 visitors an hour, and should a rush come near the closing hours, there will be sufficient tracks and trains at a substation to carry away 15,000 more people. This "Stub" system is intended for convenience in handling country visitors coming in on excursion trains. The street railway lines claim they can deliver 40,000 visitors an hour, the lake steamers 15,000 and the Alley "L" road 20,000. On the State street and the Cottage Grove avenue lines 120 trains an hour, each train having three trailers and a grip car, with a seating capacity of 150, and a crowding capacity of 50 more, will be operated at half-minute intervals. Three hundred new cars are being added to these lines. The cross-town lines are also increasing their rolling stock in anticipation of the crowds. Thus the Exposition managers are confident that, should occasion demand, they can handle 100,00 visitors an hour from within the city and 50,000 excursionists from out of town.

The Illinois Central Railroad Company is building a new passenger depot, costing over a million dollars, that will extend along the lake front from Park row to Twelfth street, with a frontage on Park row of 220 feet. Arc and incandescent lamps will furnish the illumination, and electric motors the necessary power used within the building, contracts for which have not yet been signed. The unobstructed outlook over Lake Michigan will make the waiting-room unequaled in attractiveness, while another feature will be a marble lined subway, extending the entire width of the station, with marble steps on each side, by means of which any train can be reached without crossing a single track, or climbing over platforms. The Hall Sig-

nal System is also being installed between Chicago and Kensington; and 50 engines and 500 coaches, estimated to cost over $2,000,000, will be added in time to handle the World's Fair business.

The Buildings.—Several of the buildings are already completed, and the exterior of the majority needs only the finishing touches of the painter. The Machinery Building is not yet roofed in. The Electrical Building is about two-thirds finished, and nearly the entire exterior is ready for the painter, while the names of Wheatstone, Gauss, Jacobi and other noted workers in the science of electricity appear prominently in white letters nearly a foot in height. The Transportation Building is practically finished, while the exterior of the Manufacturers' and Liberal Arts Building, with its 44 acres of floor space, in which 300,000 people could be seated, is fast approaching completion. The first of the bonded warehouses has been opened as Warehouse A, and several carloads of exhibits are stored away to await the final arrangement. Heretofore these exhibits have been placed in the various freight houses in the city, but hereafter the railway lines will deliver shipments so marked direct to the exposition warehouse. Along the lake front, that ever changing horizon-bounded expanse of blue and green that will gladden the heart of our foreign and inland visitors, is a stretch of a mile and a half of graded, curbed and paved roadway and wide promenade, embanked from the water's edge with a sloping wall of granite blocks. The long pier, extending 2,500 feet out into the lake, is well under way, and will afford ample landing room for passengers brought by lake craft. The lagoons and waterways are assuming artistic shape, reeds and other aquatic plants being placed at the water's edge, while the rich deposit of black earth is fast being covered by the soft green raiment springing up wherever its color and texture will beautify the scene. Referring to the spectacular and fantastic effects to be produced in these lagoons with the aid of electricity, a writer states that "these waterways will literally sparkle at night with tiny colored lights in unique and fantastic designs. Vari-colored lamps will glimmer in the dim green depths of the lagoons. Hidden and buried among flowers and translucent water plants, they will appear like veritable *ignis fatui*, or, as skimming over the surfaces of the water in electric launches, like giant submarine water flies. Great sea-serpents, dragons and sea nymphs will peer out of the depths of the water and cast horrible but harmless looks at the happy thousands who may glide over the rippling bosom of the World's Fair waterways. Expensive designs for this feature of the electrical display will be brought from Europe at a great expense. They will consist of Chinese dragons, winged horses, sea monsters and all the horrors of land, sea and air that the imagination of man has in the course of centuries given birth to."

At the dedication ceremonies in October the visitors will be treated to a brilliant spectacular display entitled the Progress of the Centuries, and among the 24 floats will be one representing "The Genius of Invention," application of steam, etc., and one representing "Electricity." Sixty 6,000-c. p. search lights will illumine their course through the most picturesque portion of the lagoons, and as these stately barges average 50 feet in length and 30 feet in height, it is expected that a scene of unusual splendor will result. The float representing Electricity is thus described by the designer: "This float will need no search lights to reveal its beauties. Indeed, as it approaches these lights will be darkened so that it may the more perfectly reveal its own glory. The golden barge is of capacious form. Within it seems to be filled with clouds supporting a huge sphere representing the world. This globe is banded in all directions with thousands of incandescent lamps of varying color, incessantly flashing, now green, now blue, now crimson, a hundred tints. Upon it stands an heroic figure of the Genius of Electricity, bearing aloft a brilliant electric lamp. On the high gilt prow stands Franklin with his kite. By ingenious appliances real lightning flashes are made to flash about his kite. On elevated platforms on either side of the great globe are seen Morse and Edison with their discoveries. Far forward sits a female figure representing Europe, and far behind another representing America. To the latter little winged figures are bringing messages. Her fingers rest upon a telegraphic key. Europe receives the message and reads it from a tape, while other winged figures with trumpets proclaim it to the world. This barge will be provided with powerful dynamos to produce the marvelous light effects."

Electric Fountains.—The proposition of Lieut. E. J. Spencer, of the General Electric Company, to erect two grand electric fountains surpassing in size, beauty of design, and in the variation and brilliancy of illuminating effect anything yet designed, has been accepted by the Grounds and Building Committee, and suitable locations will shortly be decided on.

Electrical Congress.—Professor Elisha Gray, chairman of the World's Congress Committee on an Electrical Congress, has returned from his trip to England, France, Germany, Austria, Roumania, Turkey, Italy and Greece, and was everywhere received with expressions of a lively interest in the Columbian Exposition and with cordial manifestations of interest in the World's Congress scheme. "If all who have the desire to come had the means to spare to bring them here, the attendance from foreign countries would be a great surprise to the American people," said Professor Gray. "I explained to those I met in the various countries the plans and purposes of the various congresses proposed. It was my special mission to give information and make arrangements in relation to the electrical congress to be held next year. Many eminent electricians of different countries are expected to attend, including a large number from Great Britain. The work of the World's Congress Auxiliary has been done so quietly that the general public is not aware of its extent and efficiency. There seems now to be no question that the world's congresses of 1893 will be very much more largely attended and will be conducted on a more imposing scale than those of any previous occasion in the world's history."

Dedication Ceremonies.—By an act of Congress and proclamation of the President, Friday, Oct. 21, will be a national holiday, and special exercises will be held in every one of the 170 schools in Chicago on Thursday, Oct. 20. No charge will be made for admission to the Fair while the dedicatory ceremonies are taking place on Friday. On Thursday and on Friday after 5 P.M. an admission of 50c. will be charged, as the fireworks and floats will be of such magnitude and such brilliancy and the expenditure will have been so great that the exposition management has decided to charge for the enjoyment of these entertainments. The fireworks will be the most elaborate ever evolved, and in many cases the bombs and display pieces will be fired by electricity.

Visitors.—That foreign buyers appreciate the magnitude and the importance of the coming electrical display may be inferred from the report of Consul Wildman to the State Department, a paragraph of which reads as follows: "At present there is but one small electric plant in Singapore, consisting of Thomson-Houston dynamos. It lights the government house and the colonial secretary's house with incandescent lights. The cost of an installation of a plant of 350 arc lights in Singapore is put at $350,000 by the municipal engineer, whose figures are based on the result of diligent inquiries in the United States and Great Britain. His Highness the Sultan of Johore, whose capital and palace are but fourteen miles from Singapore, is waiting until the Singapore authorities arrive at some definite conclusion in regard to the best methods of lighting, when he will adopt them for Johore, as he has told us that he intended to light his palace with electricity at an early date. Johore would probably require a plant of fifty arc lights. Whoever gets one contract will get both. His Highness will do nothing, however, *until he returns from the Chicago Exposition* and has seen the best results of electric lighting in America."

General Illumination.—The general plan of the exposition officials is to use arc lights in illuminating the grounds and the main buildings, save the Administration Building, the Women's Building and the Art Gallery, in which incandescent lights will be employed. A series incandescent system will probably be used on the wooded island. The exterior arc lights will be placed on iron posts of rich and attractive design rising from 16 to 20 feet in height, firmly bolted to a solid wooden foundation adjoining the manhole through which the circuit wires will come; and for carrying the arc lights and other circuits over 20 miles of underground ducts are ready for service. The arc light posts will be placed around each building, along the driveways, the piers, etc., at a distance of from 75 to 100 feet apart, affording abundance of light in all parts of the grounds and, together with the illumination from other sources, may cause the evening visitor to exclaim: "Forever shall reign the day, for the night has rolled away." When the evening visitor stands on the bridge connecting the Fisheries Building with the wooded isle, and looking south along the edge of and through the island foliage, along the canal, across the grand basin and into the entrance of the Electrical Building, he will behold light effects of wondrous beauty, far surpassing in grandeur anything ever attempted before. At his feet will be the quaint and grotesque effects produced by the varied arrangement of colored bulbs in the Japanese quarter at the end of the bridge; beyond will bloom a thousand flowers and great banks of roses, arranged with the aid of vari-colored bulbs; shooting higher in the air than the tallest building will be the many colored sprays from the two electric fountains that are to be placed on each side of the great Macmonies fountain that is emblematic of the triumphant progress of America, while between the island and the fountain will be the golden lights blazing forth from the Electricity Building; along the cornice line, 60 feet above grade of the walls of the buildings facing the Grand Basin, incandescent bulbs will be placed at close intervals, the light from which will enhance the dusky softness of the old ivory colored walls, and accentuate the artistic lines of the sculptor's work. Along the brink of the Grand Basin rows of incandescent bulbs will be placed, driving away all possibility of shadows; to the north of the bridge will be the Art Gallery with its grandly illuminated dome on which so much time and artistic skill is being expended; its mosaic flooring before the entrance reflecting back from its polished surface the myriad rays from both arc and incandescent. All this is but a faint outline of the harmoniously decorative and beautiful effects that may be studied from the footpath on the bridge, when its wealth of golden light is turned on that converts into reality this artistic dream in electrical illumination.

Dr. Allan J. Hornsby, secretary of the Electrical Department of the World's Fair, will return from his vacation on Monday.

Mr. William Bracken, of New York, was a welcome visitor in Chicago this week, closing up the contract for the building of the electric launches that are to be operated in the lagoons.

Mr. Harold Sturges, secretary of the American Battery Company, Chicago, entertained a number of his friends this week by conveying them through the principal streets, along the boulevards and through Lincoln Park in his electric carriage, a modified type of which will be used at the World's Fair grounds. The carriage was illustrated in THE ELECTRICAL WORLD some months ago, weighs 5,500 lbs. complete, including 24 cells of the American storage battery, weighing 55 lbs. each, and a Morrison motor of 2½ h. p. The carriage naturally attracted a great deal of attention, and it was quite noticeable that but one horse showed the slightest indication of alarm or fear. The speed maintained was practically constant, the average rate being over six miles an hour, and the average output 27 to 30 ampères. In ascending the steep grade at the bridge the ammeter indicated a flow of 80 ampères, and it was noticed that from 7 to 10 ampères less were required in traveling over a macadamized road than on an asphalted pavement, where the resistance was apparently greater. Later Mr. Sturges will carefully note where the same number of ampères will be required in passing a given distance and with a given load early in the morning before the sun has affected the asphalt pavement, and again in the afternoon when the sun is shining brightly.

Freight Rates for Exhibits.—The following abstract of a circular issued by the Central Traffic Association for the information of interested roads may prove of service to exhibitors: "Bills of lading covering exhibits must show the precise routes by which such exhibits are to be transported, specifying in detail every carrier from starting point to the exposition, in order that exhibited articles entitled to free return may be returned by the exact routes first used. All articles forwarded for exhibition at the exposition should be billed thereto, and will be charged full Chicago tariff rates to the fair grounds, but no charge will be less than for 100 pounds at the class rate applicable, nor less than 25 cents. To these rates there will be added a charge made by the exposition management of six cents per 100 pounds, with a minimum of 50 cents for any single shipment. These are the terminal charges for switching exhibits within the grounds, and placing them on or adjacent to the spaces allotted. This charge of six cents will be made in each direction. Exhibits weighing more than three tons each, forwarded from domestic or foreign ports, if unsold and entitled to free return, will be subject on their return to a charge of five cents per 100 pounds, with a minimum of $1 for any single shipment for transfer at seaboard points to vessels."

New York Exhibits.—The total number of applications for space received from New York parties is about 1,500; of this number 44 are in the Electricity Department and 158 in the Machinery Department.

The Souvenirs.—The Board of Directors has authorized the treasurer of the corporation to sell the souvenir half dollars at one dollar each, in sums of 50 or multiples thereof. Requests will be filed in the order received, and must be accompanied by cash or its equivalent. For the first souvenir coin Mr. F. S. Terry has offered $300, and for the first lot of 100 he offers $1,000.

F. DE L.

Earth Currents.*

BY W. H. PREECE.

The year 1892 has been remarkable in the number and severity of those electric storms which interfere so seriously with telegraphic communication. Unfortunately observations made upon them on working circuits are rarely reliable. Their arrival and departure are sudden; they come when they are least expected and they occur in busy hours when the wires are fully occupied with more remunerative currents, and when the staff is fully engaged. Their presence, duration and relative intensity are so exactly coincident with magnetic disturbances that the recorded observations in magnetic observatories of needle variations may be taken to indicate the same elements of earth currents also, but they do not give their direction nor their intensity. The general direction is determined by the simultaneous observation of many circuits running in many directions and noting the lines of maximum and those of no disturbance. This gives the position of the equipotential planes on the surface of the earth, and the intensity of the currents gives the difference of potential between these planes.

I have succeeded in obtaining definite facts that these planes are perpendicular to the line joining the centre of the earth and the centre of the sun, but there is little doubt that it is so, for telegraph circuits running in this direction experience the maximum disturbances, while those running at right angles on the equipotential planes suffer no disturbance. Those that experience the maximum disturbance in the forenoon are not affected in the evening.

The storms commenced on Jan. 4 and they have been observed at frequent intervals since.

The great storms occurred on Feb. 13, March 12, April 24, 27, May 18, July 16.

The intensity of the maximum currents observed frequently exceeded .045 ampère, or 45 milliampères, which

*Paper read at the Edinburgh Meeting of the British Association.

much exceeds in strength the working currents. Hence ordinary telegraph working was paralyzed, and we had to resort to metallic circuits and the use of condensers to maintain telegraphic communication.

The effect of such currents on our railways might be positively dangerous, for they ring bells and reverse the block signals.

Forty-five thousandths of an ampère means .54 volt per mile, so that the equipo ential planes differing by one volt would have been placed about two miles apart.

These earth currents, though variable, are always continuous and give no indication of alternations.

The simultaneous appearance of auroras shows that disturbances on the sun's photosphere, as indicated by sun spots, produce electrostatic and electromagnetic effects on the earth's surface of enormous magnitude.

Prof. Schuster on the Passage of Electricity through Gases.

The president of Section A—Mathematical and Physical Science—at the Edinburgh meeting of the British Association for the Advancement of Science, just closed, was Prof. Arthur Schuster, professor of physics at Owens College, Manchester, England.

Prof. Schuster is a native of Frankfort-on-the-Main. At first he entered upon a commercial career in England in 1869, but subsequently went to Heidelberg, where he received the degree of Ph. D. In 1881 he was appointed to the newly founded chair of Applied Mechanics at Owens College, Manchester, and six years later succeeded Prof. Stewart as Professor of Physics at the same college. Of recent years he has devoted much of his attention to the study of the discharge of electricity through gases.

When Prof. Schuster called Section A to order on Thursday, Aug. 4, the attendance of electricians and physicists was very large, including such well known men as Lord Kelvin (formerly Sir William Thomson), Prof. H. L. F. von Helmholtz, Prof. E. Wiedemann, Nikola Tesla, Prof. H. S. Carhart, and many others.

Prof. Schuster began his presidential address by saying that at such a meeting the temptation was great to look back on the year which had passed, and to select for special consideration such work published during its course as might seem to be of the greatest importance. He feared, however, that a year was too short a time to allow them to form a fair estimate of the value of a scientific investigation. But although he did not feel competent to give them a review of the progress made in their subject during the last twelve months, there was one event to which some allusion should be made. It had been the sad duty of many of his predecessors to announce the death of successful workers in the field of science, but he believed he was unique in having the pleasure of recording the birth of a scientific man—Lord Kelvin. This neat hit was warmly applauded.

Prof. Schuster went on to say that in his opinion the scientific amateur was being crowded off the field. Faraday he regarded as an amateur. Joule he also considered an amateur. He thought that if school examinations could be more general, if scientific theories could only be taught at an age when a man was able to form an independent judgment, there might be some hope of retaining that originality of ideas which had been a distinctive feature of this country, and had enabled their amateurs to hold a distinguished position in the history of science. At present a knowledge of scientific theories seemed to him to kill all knowledge of scientific facts.

Prof. Schuster added that he believed that the question of the relation between the motion of matter and the motion of medium was a vital one, and they would probably not make many serious advances until experiment had found a new opening. Important results might be expected from an investigation of the relation between electricity and the medium; and another hopeful avenue was afforded by the relation between electricity and chemical effects. The passage of electricity through gases presented a complicated problem to which a number of physicists had given attention of late years, and the president discussed some of the difficulties which the problem presented. One of his points was that the principal part in the daily variation of the magnetic needle was due to causes lying outside the surface of the earth, and was in all probability only an electro-magnetic effect due to the bodily motion in our atmosphere which showed itself in the diurnal changes of the barometer. The difference in the diurnal range between times of maximum and times of minimum sun spots was accounted for by the fact that the atmosphere was a better conductor at times of maximum sun spots. In this connection the president raised a number of questions with regard to the phenomena of sun spots, and one of these was whether it was not possible that electric discharges setting out from the sun, and accelerating artificially evaporation at the sun's surface, might cool those parts from which the discharge started and thus produce a sun spot. Another question was whether the periodicity of sun spots and the connection between sun spots and magnetic disturbances on the earth might not be due to a periodically recurring increase in the electric conductivity of the parts of space surrounding the sun. Such an increase of conductivity might be produced by meteoric matter circulating round the sun.

The address was very well received. Lord Kelvin proposing a vote of thanks, which was carried with much heartiness.

On the following day, Friday, Lord Kelvin, at his request, occupying the chair, Prof. Schuster read a paper on primary and secondary cells in which the electrolyte is a gas. Starting from the fact that when an electric discharge was passing through a tube the whole tube became a conductor, he explained that he had studied the laws of that conduction, which he calls the secondary conduction, in gas. On the theory of different physicists that the primary phenomena of discharge depended on the association of molecules, it must often, he said, have struck those who worked at it that they had never found any effects of polarization such as they had when water was decomposed into gases. In his experiments he had found no trace of polarization in the secondary conductor when an elementary gas was the medium used. When compound gases were used there was only a very small trace of polarization, but since he had introduced hydrocarbon gases he had had very marked phenomena of polarization. The manner in which the polarization fell off in these gases was the way in which it fell off when water was the electrolyte. When a steady current was passed through the gas, there was a return current as in water. This pointed to some work done by the current of the nature of electrolysis. When different electrodes were introduced, widely different results were obtained. With copper and iron very small effects of polarization were obtained, but where magnesium and aluminium were used as the electrodes these effects of polarization were increased to an enormous extent. With magnesium electrodes, if a current was passed for a long time, they got back an electromotive force of 35 volts from a single cell. That showed that it was not an ordinary effect of the decomposition of the gas, but that it was much more similar to that of secondary cells. Cases in which gas, under the influence of a primary discharge, were able to act as an electrolyte in so far as primary cells were concerned, had been already described by Prof. Reinold. He had himself made a number of experiments, and tried a number of gases, and here also he had found that aluminium was one of the most active metals, and gave remarkably uniform results.

In the discussion which followed, Prof. Helmholtz took part. Dealing principally with the luminous effects obtained by vacuum tubes, he said he considered that all chemical combinations—at least those which could be separated again by electric currents—were composed of at least two atoms, one of which was charged negatively and the other positively. In the vacuum tubes there was always a measurable quantity of air adhering to the interior of the glass, especially if they have been filled a long time with air, and there was always the possibility that the positive atom was drawn away by a positive charge near the surface of the glass, and the negative atom attracted. Prof. Helmholtz went on to speak of the liability of glass tubes from which the air had been partially exhausted to electrification by contact, and he illustrated it by pointing out how an electric light was produced by the rolling of a drop of mercury in a partially exhausted tube.

Prof. Forbes Would Utilize Refuse to Make Electric Light.

Prof. George Forbes, who is well known in America as well as in England, is the author of a scheme for burning up the refuse of cities and using the heat thus generated to produce electric lights. In a paper on the subject, "Application of Destructors Especially to the Electric Lighting of Edinburgh," at the recent meeting of the British Association, Prof. Forbes said that at the summit of Arthur Seat there is a gully looking down in the direction of Portobello which, by means of a very short dam, would enable a reservoir to be made, which would not be the least unsightly in the neighborhood of Edinburgh, which would be invisible in all directions from which Arthur Seat was such a magnificent object, and which could only be seen from the direction of Portobello. After that a pipe line could be taken down to Lochend, nearly a mile distant. The height of the reservoir would be 725 feet; that of Lochend was 83 feet. By building a dam near the summit of Arthur Seat they could get a reservoir to a height above Lochend of 605 feet, and the content of the reservoir was approximately two million cubic feet, which meant 28,800 h. p. hours—28,800 working for an hour—simply using up the water in the dam. That was on the assumption of 75 per cent. efficiency in the turbines and pipes. The cost of the pipes gave about £1 per horse power. Working from facts taken generally from the operation of central stations all over Europe, he found that they could obtain a maximum output from the 28,000 h. p. in the central station of 12,500 h. p. Supposing 3,000 continually working in the form of steam engines, the working total was 15,625 h. p. They thus saved the cost of 12,500 h. p. on pumps and engines, which would probably cost about £200,000, replacing it by pipes and turbines, which probably did not come to more than £35,000 altogether, and the reservoir. Pumping engines and turbines were now so perfect that they might expect to get a horse-power delivered for every three pounds of coal. Experience showed that including coal wasted in getting up steam and banking fires, five pounds of coal were at least required. They were thus saving about two pounds of coal per horse power by keeping the engines and boilers always working to their maximum amount. Thus with a maximum of 15,625 h. p. they had a mean output of 2,600 h. p. all the year round, and the saving of two pounds of coal per horse power amounted to 20,000 tons, which at 20s. per ton meant a saving of £20,000 per annum. Leaving that point, he said he had a few remarks to make on the use of destructors. There was no doubt that the use of destructors for getting rid of refuse and getting up steam for electric lighting purposes would play an important part in the future. In Edinburgh they would be able to use destructors with the utmost advantage, as the difficulty regarding hydraulic storage was done away with. He then briefly described the destructor used in Leeds; and in his concluding remarks he said that what was wanted was an inventor to come forward with some means of storage which would be applicable to continual or alternating currents.

The staid and dignified British scientist on occasion indulges in a little pleasantry, though readers of some of the English professional journals might not get that impression.

A clever impromptu epigram upon Professor Forbes' suggestion was sent to an Edinburgh daily paper by one of the best known (as well as one of the most modest) electrical engineers in England. THE ELECTRICAL WORLD was permitted to make a copy of the epigram before it was sent to the Edinburgh paper, and it is published herewith for the benefit of American electricians:

The Alchymist old, as I'm sure you're aware,
Turned stone into gold by fasting and prayer.
The Alchymist new, Forbes his name, has a plan
For turning town rubbish to light by a dam.

Annual Report of the West End Street Railway, Boston, Mass.

The West End Street Railway Company, of Boston, operates, perhaps, the largest system of electric railways in the country, and its earning capacity and other items in connection with its financial standing and success are interesting in comparison with those of other electric systems in demonstrating doubtful facts as to the efficiency and economy of electric motive power in large cities. Since 1887, when the West End system was formed by the consolidation of four companies, it has maintained a steady advance in perfecting a service which it has had to render under the disadvantages of a city not at all adapted for rapid transit. The principal item of its progress has been its gradual evolution from horse power to electric power. On the one hand it has at all times met the requirements of the public in all sections of the city; on the other hand, it has offered to investors a most profitable security, basing its reputation on actual net earnings. The following table shows the remarkable growth of the earnings from the cars alone during the history of the company:

	1887-8.	1888-9.	1889-90.	1890 1.	1891 2.
October	$421,066	$4 8.935	$458,834	$513 779	$541,435
November	391.349	410.190	449,363	494,459	490 227
December	372,578	412.466	439 893	463 305	497.836
January	327,876	381.255	399,784	427,502	449,208
February	323.442	336,472	381.058	398,080	427.524
March	350,212	381,576	419,876	444,138	468,556
April	376,594	409,611	451.486	474.072	503,175
May	420,131	478.630	508,233	514 731	534,705
June	481.978	494.244	531.271	544.897	593,116
July	460 249	490.321	545.081	549.343	596,157
August	454,853	477.762	577,371	522,789	.....
September	427,938	465.928	511,486	539,506	.....

The company now controls 266 miles of track, one-half of which is practically new, having been rebuilt for the change to electricity. Besides this, the equipment of the road has likewise kept pace with the growth under the electric system. The electric mileage is now about two-thirds of the whole; and by Jan. 1, 1893, probably seven-eighths of the mileage will be electric, or 15,000,000 miles for the year. The following table shows the progress of the electric system and its effect on the net earnings.

Horse cars.—Nine months.

	1891.	1892.
Miles run	9,615,736	7,258,689
Net earnings	$543,437.34	$367.036.18
Net earnings per car mile	5¾ cts.	5 cts.

Electric cars.—Nine months.

Miles run	3,494,231	5,477,471
Net earnings	$342 765.01	$810.024. 0
Net earnings per car mile	10 cts.	15 cts.

Electric.—Three months.

	1891.	1892.
Total mileage	1.131,347	2.280,012
Total earnings	$432.947.70	$950.446.89
Net earnings	179,069.17	418.648.43
Net earnings per car mile	16 cts.	19 cts.

Estimated earnings of electric cars for current year.

	Nine months.	Three months. Estimated.	Total
Total mileage	12 736 260	4.500,000	17,236,260
Electric mileage	5.477.571	3,000 000	8.477.571
Net earnings	$810,024	$270,000	$1 380,024
Net earnings per car mile	.....	.....	16 cts.

These figures show the comparative profit of the electrics and horse cars. With all these lines equipped with electricity, even were mileage and net earnings not to increase, it is evident that the complete use of electricity will wonderfully increase the earning capacity of the property. In 1888 the operating expenses were 78.29 per cent.; in 1891 they were reduced to 74.48 per cent. Every year the earnings have been sufficient to pay the interest on the funded debt, 8 per cent. on the preferred stock and 10 per cent. on all outstanding common stock, of which latter stock there are $9,000,000 now outstanding. The fixed charges and dividends of the current year, as estimated, aggregate about $1,850,000. The net earnings of the past ten months are about $1,410,000, and, estimating from previous months, the total for the year will be in excess of the amount re-

quired to meet all charges and dividends. The company is charging to depreciation of horses $11,000 per month and a large amount of track repairs to operating expenses.

The next problem which the company has to solve is that of rapid transit between distant portions of the city, either by elevated or underground railways in conjunction with the present surface roads. The growth of the city demands this and the success of the West End company and its ability for bringing about results in an eminently successful manner will bring upon it the necessity of meeting this demand in the near future.

Diminution of Fire Hazard Since Introduction of Electricity.

BY JOHN McGHIE.

One of the most prominent questions before fire insurance underwriters to-day is that brought up by the extensive and ex ending adoption of electricity in buildings as an illuminant and as a motive power. It is a question that may be narrowed down to its relation to the increase or decrease of risk on buildings insured or about to be insured by the fire insurance companies, and its aim is the elicitation of authoritative information as to whether the hazard on buildings from the purely insurance point of view is increased by the introduction of the electrical current, either for the purpose of illumination or for motor service; or whether, on the contrary, it is not rather diminished where a comparison is instituted between buildings equipped with gas and the steam engine, and those served by electricity alone or gas and electricity in combination.

Before considering this question and the points involved, the present aspect of the subject matter in dispute should be stated. The electric current has become practically ubiquitous. Our cities are pierced with the wires underground, while between them and the sun hangs a gossamer network of aerial conductors. The current has invaded our office and our home, our shops and our mills, and tentatively advancing, at first, it has come in magnitude with every appearance of staying. There can be no doubt that a discussion of the question with the fire underwriters, as a body, will reveal a lively prejudice against electricity in any shape or form, whether the current be alternating or direct or of high or low tension. It is to them a *bête noire*, to whose baleful influence is to be ascribed all the mysterious fires which have occurred during the past few years, the cause of which neither the fire marshal nor the insurance inspector has been able to discover; and, already, at the door of electricity are heaped maledictions without end. The reason for such a state of feeling is not far to seek. It is due solely to the fact that the science of electricity is practically new, and the general knowledge concerning it, therefore, extremely meagre. The powers of electricity, already manifold, still possess a glamor of the supernatural for those whose acquaintance with it is almost *nil*, and to those whose only knowledge of it is that gleaned from the desultory paragraphs in the daily press or the expressions of men whose knowledge is chiefly conjecture, the most wonderful and valuable of modern agencies has become a frightful bogey of possible danger and devastation. It is, therefore, no matter of surprise when we hear that the fire underwriters, in company with the major part of the population, ascribe mysterious conflagrations in electrically equipped buildings to the electric spark, produced by the objectionable short circuit.

Successfully to combat this prejudice and prove its unreasonableness has been for the past few years the constant aim of the companies manufacturing and supplying electricity and electrical apparatus, but their progress in this direction has so far been rather discouraging. The underwriters have, it must be confessed, manifested in the past no marked inclination to confer with the electrical companies on questions of vital mutual interest, but may be said rather to have held aloof from them and to have regarded them with an air of deep distrust. That this course of action has seriously handicapped the electrical companies cannot be denied. They have worked hard and long in the direction of obtaining a free acceptance of the changed conditions by the insurance companies, but at every step almost have come into contact with this prejudicial feeling militating against them.

It can hardly be advanced, however, with any degree of absolute certainty, that the fire underwriters have no righteous reason for their prejudice against electricity. They have to rely on their tables and statistics drawn up by their experts. Claims have been presented to them for damages clearly attributable to electricity. The underwriters have drawn their own inferences, and electricity has been placed on their *index expurgatorius* as an extra hazard. To meet this hazard and diminish its destructive effects, sets of rules for the electrical equipment of buildings have been drawn up from time to time by the underwriters of different States, and these have been curtailed or amplified as the necessity has seemed to them to exist. As a rule these directions and instructions are far from being worthless. Indeed, in many respects, they may be deemed excellent.

Designed to render electrically equipped buildings more secure against chance of fire, they have fulfilled a most useful purpose. The difficulty which they have encountered, however, is, that their enforcement has been impracticable in the present state of the electrical business. To protect themselves, therefore, in the most effective way known to them, high rates of premium have been asked on all electrically equipped buildings—rates which to the electrically equipping company and the owners wear an appearance of exorbitance. Such a proceeding is one that will certainly show in the balance sheet of the insurance company most tangible results, although to the insured it appears a high-handed business method. The insurance company says, in effect, "either pay to us our price or try elsewhere," knowing well that the latter alternative is unavailable. The would-be insured, therefore, pays the price asked with as good a grace as possible.

Such, then, is the present state of the case. We come, therefore, again to the main question: Does electricity introduce an additional risk into fire insurance, or does it not actually decrease the risk already existing?

To the first part of the question, it must be admitted that the risk is increased under certain conditions. The risk is increased where the introduction of electricity into a building is effected by workmen not thoroughly acquainted with the requirements of their task, men whose reputation is not such as to guarantee a perfectly honest fulfillment of their contract; men whose principal interest is to ignore principle; men who really do not know what good material is, or who, bidding in competition at a low figure, are cognizant of the fact that they cannot afford to install in a manner which insures the absence of risk, but who trust to receive their certification and their contract price before any great defect in their performance is discovered. Of these self-styled electricians there are many in the profession. Their excuse for existence, however, is one which would not appeal strongly to reputable electricians or to underwriters. In this era of cheapness this class of conscienceless workmen thrives, and, moreover, thrives more lustily because of the ignorance of their employers.

Assurances are given that the work shall be done in the most approved and workmanlike manner, that the best insulation and insulated wire only shall be used, and that every possible precaution shall be taken to prevent the current from getting beyond control. But these assurances are not lived up to, and when defects develop, as they manifestly eventually will, they are ascribed to other workmen —the carpenter, plumber or others—on the principle of *les absents ont toujours tort*. The blame for this state of things might be attributed to the present existing keenness of competition between electrical contractors, were it not that the competition of these cheap men is of a disloyal and dishonest character, pandering to the avaricious desire of the house owner to have his work done at the lowest possible figure, which desire frequently serves as a hoodwink to prevent him from too closely investigating the reputation and qualifications of the cheapest bidder to whom the contract is awarded. Ignorance of electricity and the best methods of its control also prevent the owner from personally intelligently investigating the work done for him. Cheapness of price below the figures of firms of high standing is only reached by sacrificing the quality of the work and this can be taken as an axiom, the truth of which the owner always subsequently discovers.

The cheap, careless and inefficient contractor, therefore, must be eliminated before it can with certainty be said that the introduction of electricity has not increased the insurance risk.

Has the introduction of electricity lessened the risk incurred by the insurer? This part of the question is one which all members of the electrical profession, thoroughly competent, from long practice and hard experience in the science of electricity to emit an impartial and authoritative opinion, will be inclined to answer in the affirmative. The supersession by the electric current of many dangerous elements formerly inseparable from residences, mills, shops, factories and office buildings, is a fact beyond dispute. The little upright flame of the gas jet, and the ever-present, ubiquitous match, used in conjunction therewith, have disappeared from numerous places in which their presence was a constant menace to property and life. The leak in the gas pipe or the insufficiently turned gas cock, whereby the noxious vapor could be distributed all through a building, and an explosion rendered almost inevitable, have received their quietus since the electric current has been adopted. The use of the kerosene lamp is dwindling away, until it will finally disappear, to become a source of deep conjecture in the dim future to pondering, investigating antiquarians.

The former all-pervading use of the steam engine is now curtailed and the dangers attendant upon it obviated. Instead of an engine with boilers and furnaces in every factory, jeopardizing the safety of the building by the actual presence of a roaring fire, or from overheated parts, the electric motor is substituted and the dangerous elements relegated to a more fitting position in a small, inexpensive building at a non-dangerous distance from the main building. This small building will contain, besides the steam plant and boiler battery, the generators of the electrical current, and from these, by insulated cables, the electricity is conducted to its points of application, viz., the motors in the main building. The chance of fire in such an installation as this is reduced to as nearly a minimum as possible. The spark from the fire cannot reach the main building to endanger it; the shortcomings of the steam plant are all restricted to the small buildings, beyond the confines of which they cannot escape. An excellent instance of the absolute security of works having their steam plant thus installed is shown in the works of one of our largest manufacturing concerns, where electricity is furnished to fifty-three buildings as an illuminant and as a motive power, from the power house situated in the centre of the group. Such a thing as a fire from electrical causes in such a plant as this is an impossibility.

Under such conditions, therefore, it can safely be advanced that the introduction of electricity has decreased the risk in fire insurance.

Each building wired for electricity is examined, or is supposed to be examined, by an expert inspector, whose certification is the authority for the course pursued by the underwriter. The following are the principal requirements which should be insisted on by the insurance inspector and owner, and certification of approval should be rigidly refused until they have been complied with:

(1) The firm employed to carry out the electric lighting should bear an irreproachable reputation, both as to the possession of the requisite electrical knowledge and of the judgment necessary to the selection of strictly first class material for the work. For this it should hold government or reliable society certificates of competency.

(2) The wire used should be amply capable of carrying the requisite amount of current and even more, and should be provided with as perfectly attainable an insulation as possible. The insulation should be able successfully to resist both abrasion and depreciation through lapse of time. No insulation is known which will combine the elements of both cheapness and absolute security, and it therefore becomes an unavoidable necessity for the wires to be purchased from such wire manufacturers as are known only to furnish the best quality.

(3) All wiring should either be visible, or so arranged as to admit of frequent inspection. The concealment of wires is fraught with considerable danger, and inspection is almost impossible. If molding be used, the covers should be of lengths so short as to allow of easy removal for the purpose of scrutiny.

(4) If the current be taken from the street mains, every precaution should be exercised in providing the requsite safety devices to obviate all chance of possible danger from fire; and if the electric plant be located in the building itself, the room in which it is situated should be rendered fireproof beyond question. Half way measures in this case should be absolutely discarded.

(5) As moisture is an additional evil, care should be exercised as far as possible to guard against its invasion. The present excellence of electrical apparatus of standard make insures protection, and this alone should be made use of.

As the public becomes more intimately acquainted with the powers inherent in electricity and the scientific laws governing its operation, stronger and more comprehensive measures will be taken properly to control it. Of this there are already many signs. The fire underwriters have recently shown themselves less disinclined to scout the opinions of the electrical companies, and, in certain isolated cases, have even sought from them counsel and advice. A common ground of agreement exists, and, although it has not yet been discovered, everything now portends that it speedily will be. A basis of mutual agreement once found, the present bickerings and recriminations between electrical and fire insurance companies will cease, and everybody concerned will immediately—and let us hope continuously—be benefited.

Long Distance Transmission Plant at Macon, Ga.

BY W. FURLOW HOLT.

Macon, Ga., is a town of some 40,000 inhabitants, with 28 miles of electric street car lines and one electric light plant. The street car lines and lighting plant are owned by four different corporations, which combined furnish about 1,000 electrical horse power, all of which is generated by four separate steam plants. Only continuous current systems are used.

Now, flowing by this town is the Ocmulgee River, which has a capacity of about 113 h. p. to every foot of fall. Where the river passes the town it is a sluggish stream, only having a fall of some six inches to the mile. Eight miles north of the town, however, there are rapids where, for a distance of some five miles, the river has a fall of eight feet to the mile, and is subject to a rise in extreme high water of some 22½ feet.

It is proposed to put a dam 18 feet high across the river at a point nine miles distant from the town, and to cut a canal or race one mile long of sufficient capacity to carry all of the water in the river. During the low water stage this will give a head of about 26 feet and a capacity of about 2,600 h. p. It is also proposed to build the inside bank of the canal next to the river some distance above high water mark, so that when there is a rise in the river it can be utilized at the turbines, and will overcome the increased resistance from the tail water pressure; or, in other words, when there is four feet of water flowing over the dam there will be four feet more water in the canal for use at the turbines. At the low water stage five turbines will give 1,500 h. p. under a 26-foot head. These same wheels only give 700 h. p. under a nine-foot head, which will be the head available during the high stage of water. But there will be twice as great a volume of water, and eleven wheels can be run, which will give the same power.

The turbines will make 91 revolutions per minute during the low water period, but will not make more than 80 when the water is high. To overcome this variation in speed it is proposed to use on the main and counter shaft pulleys of three different diameters, which may be cut in

or out as the stage of the water may require, and which will give the dynamos run from counter shaft about the same speed under all conditions of water.

The dynamos are to be of the alternating type and of sufficient capacity to generate 1,350 h. p. Current is to be conveyed a distance of eight miles, where it will run three alternating motors of 300 h. p. each. These motors in turn will run continuous current generators to generate power for the street railways and for motor and arc light circuits throughout the city. One hundred horse power will be used directly for incandescent lighting. Each circuit from generating to distributing station will be a complete metallic circuit. Oil insulators will be used and lightning arresters will be placed every mile on the line and will form a ground with a plate placed in the river which the line follows.

The estimated loss is about 31 per cent., 8 per cent. between the turbines and generators, and a loss of 23 per cent. in line, motors, etc. This will give available in Macon about 1,000 h. p. On this basis there can be sold from 1,200 h. p. to 1,500 h. p., as it is not possible that every motor and light will run at the same time. In some cases plants that only have a showing of 600 h. p. at the generating station sell and receive pay for 1,000 h. p.

I have noticed in recent issues of THE ELECTRICAL WORLD some very interesting articles in reference to public roads and electricity, the use of electric power for farm purposes and for railways. The plant which I have briefly described will be excellently situated for experiments of this nature. The line will for a distance of eight miles run parallel to a river, a railroad, and a public road or highway, besides passing very near to large tracts of tillable land.

Electro-Metallurgy.—X.*

BY F. M. F. CAZIN.

11. RESISTANCE TO FREE ELECTRIC ENERGY BY LIQUID CONDUCTORS IN GENERAL AND ELECTROLYTES IN SPECIAL.

Although well and generally known the laws relating to conductors and directly to the measurement of resistance (R) may, on account of their importance in practical electro-metallurgy, be here repeated:

(1) Resistance to transmission of free electric energy (E) increases with the length of the conductor (L), equal material being considered.

(2) Resistance (R) to transmission of free electric energy (E) decreases proportionately to the increase of area of the transverse section of the conductor ($T\,s$), equal material being considered.

And the following equations illustrate these facts:

$$R = \frac{L}{T\,s}\begin{cases}\dfrac{1000m}{0{\cdot}001^2} = \dfrac{1{,}000}{0.000001} = 0.001\\[2ex] \dfrac{1{,}000\times 100}{0.001^2\times 100} = 0.001\end{cases}$$

It appears therefrom that resistance to electric energy or its equivalent electric pressure is a value of one dimension, because L (length) $\times$ $T\,s$ (transverse section) = volume; dimension $\times$ 2 dimensions = 3 dimensions; length $\times$ area = volume.

Thereby the analogy between the electric value R and the kinetic value of "Head" $= L = \frac{v^2}{2\,g}$ is further established, and electricians would do meritorious work if they would determine on their value g, viz., twice the distance passed in the first second by the electric current in the direction of its natural neutralization. †

And again, the relation of the value C as transverse section, area to the value R becomes thus apparent, and only the precise value g is wanting to find an electrical equivalent for the kinetic equations:

$$P = f\times v\times\frac{v^2}{2\,g}$$

R = Transverse section × quantity per second × head

(3) The resistance (R) offered by any conductor of electrical energy is proportionate to its matter at an experimental rate ($= Rc$), therefore it is the product of its *length* (L) in the *coefficient of resistance by its material* ($c\ R$) divided by its *transverse section*

$$R = \frac{L\times Rc}{T\,s}$$

And these coefficients of resistance ($c\ R$) for different metals are:

For copper = 1.00 or 0.0210 relative to mercury = 1.
For silver = 0.77 — 0.0163.
For gold = 1.38.
For aluminium = 2.29 — 0.0482.
For zinc = 2.82 — 0.0594.
For iron = 6.76 — 0.1129.
For platinum = 7.35 — 0.1548.
For lead = 9 96 — 0.2098.
For antimony = 18 07.
For mercury = 47.48 — 1.0000.
For bismuth = 64.52
For graphite = 1106.00.
For gascoke (pressed) = 2037.00.

These values increase as the temperature of the conductor rises.

Chemically pure metals offer less resistance than impure metal, alloys or metal compounds with metalloids.

In electro-metallurgical practice anodes of natural metallic compounds are employed and their electric conductivity is then of importance. Metal compounds with sulphur offer less resistance than those with oxygen, their physical qualities being nearer to those of pure metal than those of oxygenated compounds.

If free electric energy on its shortest road to its own electric neutralization has to pass through a conductor, the conducting capability of which is less than the requirement of such free electric energy, then the electric energy is modified into free heat energy, by which the temperature of the conductor rises mainly at the points of greatest resistance.

If liquids offered none or but little resistance to the transmission of electric energy, or, in other words, if they were as good conductors as solid metals, then electrolytic action would not evolve at all, and liquid electrolytes would not be instrumental to chemical decomposition, which is the result of applied electric energy, where its free passage is impeded.

If the electric energy that meets the liquid on its shortest road to its neutralization, and, in the absence of any other conductor, is greater than the capability of the liquid (electrolyte) to conduct such electrical energy, then the electrical energy is modified into heat energy, and such heat energy is simultaneously absorbed by the disunion of the chemical components, where such are present.

But if the electrical energy that meets on its most direct road, or only possible road, to its own electric neutralization with a liquid (electrolyte), the capability of conducting electric energy of which is equal to the requirement, such electric energy passes the liquid, as it passes any other adequate conductor, without either heating or decomposing it.

Increase of electric pressure causes an increased requirement of conductivity, and at the point where this conductivity begins to fail, the energy of chemical affinity, latent in the conductor, is compensated and modified into free energy of chemical affinity by the electrical energy becoming latent in such modification, and by the affianced components being disengaged and made free to exercise their energy of affinity.

It can therefore be stated that the conductivity of any electrolyte is less than the equivalent to $2\,\frac{c\,N}{c\,P}$ volts, or less than the equivalent of electric pressure, under which it decomposes. Therefore, the value of $c = R\,(4)$ can never be as large as that of $a = R\,(1)$. And $2\,R\,(1)$ will, even in any extreme case, overcome the resistance $= a + c = R(1) + R(4)$. And $3\,R(1) = 3\times 2.\frac{c\,N}{c\,P}$ will, in all cases overcome the total resistance $R\,(5) = a + b + c = R\,(1) + R\,(3) + R\,(4)$.

It remains to state what we know about specific resistances in specific electrolytes, and what action will lessen such resistance.

Liquids offer less resistance as their temperature rises, or behave in this particular inversely to solids.

Acidulous liquids offer less resistance than neutral or basic liquids; and the resistance decreases as the density of the solution increases.

The resistance of the electrolyte as a conductor being less than the pressure required for its decomposition, the value of such resistance can be measured under application of a current of less pressure than $2\,\frac{c\,N}{c\,T}$

In the following table the specific resistances of solutions of metal compounds and of acids are stated, as they vary for different densities of these solutions at different temperatures.

TABLE OF SPECIAL RESISTANCES OF SOLUTIONS OF METAL COMPOUNDS AND OF ACIDS TO THE ELECTRIC CURRENT IN OHMS AT DIFFERENT DENSITIES AND TEMPERATURES OF SUCH SOLUTIONS, AS ESTABLISHED BY G. WIEDEMANN, F. KOHLRAUSCH, GROTIAN, NIPPOLDT AND BECQUEREL.

Metal compound dissolved in the electrolyte.	Per cent. of the solution in weight of compound therein dissolved.	Consequent density of the solution.	The resistance in ohms of a volume of the electrolyte of 0 1² m., the current passing squarely, at a stated degree C.	Per cent. of reduction of such resistance per 1° C. of temperature of electrolyte
KCl at 18°.	5	1.0308	1.4636	2.02
	10	1.0638	0.7422	1.89
	15	1.0978	0.4904	1.80
	20	1.1335	0.3767	1.69
	25	1.1408	0.3590	1.67
NH_4Cl at 18°C.	5	1.0142	1.0983	1.99
	10	1.0289	0.5680	1.87
	15	1.0430	0.3900	1.72
	20	1.0571	0.2998	1.62
	25	1.0710	0.2505	1.55
NaCl at 18° C.	5	1.0345	1.5022	2.18
	10	1.0707	0.8334	2.15
	15	1.1087	0.6146	2.13
	20	1.1477	0.5155	2.17
	25	1.1898	0.4726	2.28
	26.4	1.2014	0.4680	2.34
$CaCl_2$ at 18° C.	5	1.0409	1.5697	2.14
	10	1.0852	0.8841	2.07
	15	1.1311	0.6705	2.03
	20	1.1794	0.5838	2.01
	25	1.2305	0.5666	2.05
	30	1.2841	0.6086	2.17
	35	1.3420	0.7388	2.37
$CuCl_2$ at 9.25° C.	Saturated and diluted to 4 volumes.	.....	4.157	
	Saturated and diluted to 2 volumes.	.....	2.379	
	Saturated.....	1.4308	1 455	
*K Cy at 15° C.	3.25	1.0154	1.9100	2.08
	6.5	1.0316	0.9806	1.94
KNO_3 at 18° C.	5	1.0305	2.2145	2.09
	10	1 0632	1.2002	2.06
	15	1.0970	0 8484	2.03
	20	1.1330	0 6686	1.98
	22	1.1480	0.6194	1.95
$NaNO_3$ at 18°C	5	1 0327	2.3122	2.22
	10	1.0681	1.2887	2 19
	20	1.1435	0.7739	2.16
	30	1.2278	0 6281	2.21
$AgNO_3$ at 18°C	5	1.0422	3.9470	2.19
	10	1.0893	2.1200	2.18
	15	1.1404	1.4780	2 16
	20	1.1958	1.1570	2 13
	25	1.2555	0.9538	2.11
	30	1.3213	0.8147	2.10
	35	1.3945	0.7179	2.08
	40	1.4773	0.6453	2.06
	45	1.570	0.5885	2.05
	50	1.6745	0.5443	2.06
	55	1.7895	0.5091	2 07
	60	1.9158	0.4808	2.10
$Cu(NO_3)_2$ at 14°–15°	In 1 litre of water 24.47 gm	.....	5.961	
	In 1 litre of water 45.81 "	.....	3 335	
	In 1 litre of water 68.72 "	.....	2.403	
	In 1 litre of water 91.63 "	.....	2.019	
K_2SO_4 at 18°.	5	1.0395	2 199	2.17
	10	1 0813	1.170	2.04
Na_2SO_4 at 18°.	5	1.0450	2.463	2.37
	10	1.0915	1.465	2.50
	15	1.1426	1.136	2.57
$ZnSO_4$ at 18°.	5	1.0509	5.270	2.24
	10	1.1069	3.134	2.26
	15	1.1675	2.425	2.29
	20	1.2323	2.149	2.42
	25	1.3045	2.096	2.59
	30	1.3788	2.268	2.74
$CuSO_4$ at 18°C.	2.5	1.0244	9.249	2.14
	5.0	1.0513	5 330	2.17
	10.0	1 1073	3.144	2.19
	15.0	1.1675	2.388	2.32
	17.5	1 2003	2.194	2.37
H_2SO_4.	1	.....	2.1997	1.12
	2.5	1.0161	0.9249	1.15
	5	1.0331	0.4833	1.21
	10	1.0673	0.2574	1.28
	15	1.1036	0.1855	1.36
	20	1.1414	0.1544	1.45
	25	1.1807	0.1406	1 54
	30	1.2207	0.1365	1.62
	35	1.2625	0.1392	1 70
	40	1.3056	0.1483	1.78
	45	1.3508	0.1636	1.86
	50	1.3984	0.1866	1.93
	55	1.4487	0.2204	2.01
	60	1.5019	0.2705	2.13
	65	1.5577	0.3466	2.30
	70	1 6146	0.4679	2.56
	75	1.6734	0.6639	2.91
	78	.....	0 8147	3.23
	80	1.7320	0.9141	3.49
	81	.....	0.9577	3.59
	82	.....	0 9962	3.65
	83	.....	1.0210	3.69
	84	.....	1.0310	3.69
	85	1.7827	1.0300	3.65
	86	.....	0.0180	3.57
	87	.....	0.9993	3.49
	88	.....	0.9775	3.39
	89	.....	0.9568	3.30
	90	1.8167	0.9387	3.20
	91	.....	0.9230	3.08
	92	.....	0.9159	2 95
	93	.....	0.9213	2.85
	94	.....	0.9424	2.80
	95	1.8368	0.9847	2.79
	96	.....	1.0660	2 80
	97	1.8390	1.2580	2.86
	99.4	1 8354	11.8000	4.00
HCl.	5	1.0242	0.2554	1.59
	10	1 049	0.1578	1.57
	15	1.0744	0.1352	1.56
	20	1.1001	0.1323	1.55
	25	1.1262	0.1394	1.54
	30	1 1524	0.1522	1.53
	35	1.1775	0.1704	1.52
	40	1.2007	0.1955	....

*The author regrets not to be able to give the data for KS_2, although they are of practical importance, in so far as in this solution the salvation for the otherwise failing McArthur process can be found.

*For the ninth section of this article see THE ELECTRICAL WORLD of Aug. 13, 1892.

The following corrections should be made in the two preceding parts of this series:

On page 91 of Vol. XX., No. 6, first column, sixteenth line from below read: As "against" the space. On same page, fourth line from below, read: Is exercised on the "faculty" of conducting, etc., and next line: Current "by the temperature of the electrolyte," commencing which, etc. On same page, second column, ninth line, from top, interchange the position of "cathion" and "anion." On the same page, third column, read in the nonpareil quotation of claim 6 of the Mochin's patent, last line but one, is "prevented" substantially, etc. On page 106 of Vol. XX, No. 7, 3d column, 24th line from top read "leaving" the curve. On same page in same column, 3d last part of table read from Pb down: $\frac{13}{2}$, 2, 4, $\frac{11}{6}$, $\frac{22}{6}$, 2, $\frac{7}{4}$, $\frac{7}{6}$, $\frac{21}{16}$, $\frac{1}{2}$. On same page same column read

$$\text{as } R\,(6) = a\,(1) + a\,(2) + b + c$$

On same page, same column and at the end the following: The last column of the table gives a consequence of energy, being measured by quantity of negative matter engaged in the reaction, and of $C\,O_2$ being formed without modification of volume as between components and compound, and of 3,030 calories being the effect of the combustion with one weight-unit of oxygen—the experimental co-efficient "$c\,V$" of modification of energy resulting from modification of volume. Therefore

$$a\,(1) + a\,(2) = R\,(1) = 2\,\frac{c\,N}{c\,P}\times V.$$

On page 107, following, read in fifth line from top: And by the "modification" of volume, and eleventh line from end: Increase of "active" pressure.

† Already the acceptance of $1 + g = 1$ watt has necessitated such a definition on account of the consequences to be drawn from such acceptance. This point will be discussed when speaking of instruments of electrical measurement.

Power Distribution from Central Stations.*—I.

BY PROF. W. CAWTHORNE UNWIN.

Here in Edinburgh one remembers that the birthplace of the steam engine is near at hand. A century and a quarter ago James Watt made an invention which has profoundly influenced all the conditions of social, national, commercial and industrial life. It is due to the steam engine more than to any other single cause that the population in this country has tripled since the beginning of the century, and that we have become dependent on steam power for fuel, for transport, for manufactures, in many cases for water supply, for sanitation, and for artificial light. From some German statistics it appears that there are probably now in the world employed in industry steam engines exerting 49,000,000 h. p., besides locomotives exerting 6,000,000 h. p. Engines in steamships are not included. The steam engine has become a potent factor in civilization, because it places at our disposal mechanical energy at a sufficiently low cost, and the efforts of engineers have been steadily directed to diminishing the cost at which steam power is produced. Members of one great branch of our profession are much concerned in the production of mechanical energy at a sufficently cheap rate. They require it in very large quantity for transformation into light and for retransformation into mechanical energy under conditions more convenient than the direct use of steam power. Perhaps it will not be inappropriate if in Section G I first discuss briefly some of the causes which have made the steam engine inefficient, and the extent to which we are getting to a scientific knowledge of the methods of evading them. I propose then to consider some of the methods of economizing the cost and increasing the convenience of mechanical power by generating it at central stations and distributing it, and, lastly, how far means of transporting energy are likely to make available cheaper sources of energy than steam power.

Let us go back for a moment to James Watt. The most distinct feature about the invention of the steam engine is that it arose out of studies of such questions as the relation of pressure and temperature of steam, the heat absorbed in producing it, and its volume at different pressures.

Armed with this knowledge, Watt was able to determine that the quantity of steam used in a model atmospheric engine was enormously greater than that due to the volume described by the piston. There was waste or loss. To discover the loss was to get on the path of finding a remedy. The separate condenser, by diminishing cylinder condensation, annulled a great part of the loss. So great was Watt's insight into the action of the engine that he was able to leave it so perfect that, except in one respect, little remained for succeeding engine builders, except to perfect the machines for its manufacture, to improve its details, and to adapt it to new purposes. Now it very early became clear that there were two directions of advance which ought to secure greater economy. Simple mechanical indications showed that increased expansion ought to insure increased economy. Thermodynamic considerations indicated that higher pressures, involving a greater temperature range of working, ought to secure greater economy. But in attempting to advance in either of these directions, engineers were more or less disappointed. Some of Watt's engines worked with 5 lbs. of coal per indicated horse power per hour. Many engines with greater pressures and longer expansions have done but little better. The history of steam engine improvement for a quarter of a century has been an attempt to secure the advantages of high pressures and high ratios of expansion. The difficulty to be overcome has proved to be due to the same cause as the inefficiency of Watt's model engine. The separate condenser diminished but it did not annul the action of the cylinder wall. The first experiments which really startled thoughtful steam engineers were those made by Mr. Isherwood, between 1860 and 1865. Mr. Isherwood showed that in engines such as those then in use in the United States Navy, with the large cylinders and low speeds then prevalent, any expansion of the steam beyond three times led, not to an increased economy, but to an increased consumption of steam. Very little later than this M. Hirn undertook, in 1871–5, his classical researches on the action of the steam in an engine of about 150 indicated horse power. Experiments of greater accuracy or completeness, or of greater insight into the conditions which were important, have never since been made, and Hirn, with his assistants, MM. Hallauer and Dwelshauver Dery, has determined, once for all, the whole method of a perfect steam engine trial. M Hirn was the first to clearly realize that the indicator gives the means of determining the steam present in the cylinder during every period of the cycle of the engine. Consequently, superheating in ordinary cases being out of the question, we have the means of determining the heat present and the heat already converted into work. The heat delivered into the engine is known from boiler measurements, combined with calorimetric tests of the quality of the steam, tests which Hirn was the first to undertake. The balance or heat unaccounted for is, then, a waste or loss due to causes which have to be investigated. Hirn originated a complete method of analysis of an engine test, showing at every stage of the operation the heat accounted for and a balance of heat unaccounted for, and the latter proved to be a very considerable quantity.

Meanwhile theoretical writers, especially Rankine and Clausius, had been perfecting a thermodynamic theory of the steam engine, based primarily on the remarkable and irrefragable principle of Carnot. The result of Hirn's analysis was to show that these theories, applied to the actual steam engine, were liable to lead to errors of 50 or 60 per cent., the single false assumption made being that the interaction between the walls of the cylinder and the steam was an action small enough to be negligible.

In this country Mr. Mair Rumley, following Hirn's method, made a series of experiments on actual engines with great care and accuracy and completeness. All these experiments demonstrate the fact of a large initial condensation of steam on the walls of the cylinder, alike in jacketed and unjacketed engines. This condensed steam is re-evaporated partially during expansion, but mainly during exhaust, and serves as a mere carrier of heat from boiler to condenser in conditions not permitting its utilization in producing work.

It became clear from Hirn's experiments, if not from the earlier experiments of Isherwood, that for each engine there is a particular ratio of expansion for which the steam expenditure per horse power is least. Prof. Dery has since deduced from them that the practical condition of securing the greatest efficiency is that the steam at release should be nearly dry. In producing that dryness the jacket has an important influence. In spite of much controversy among practical engineers about the use of the jacket, it does not appear that any trustworthy experiment has yet been adduced in which there was an actual loss of efficiency due to the jacket. In the older type of comparatively slow engines it is a rule that the greater the jacket condensation the greater the economy of steam, even when the jacket condensation approaches 20 per cent. of all the steam used. It appears, however, that as the speed of the engine increases, the influence of the jacket diminishes, so that for any engine there is a limit of speed at which the value of the jacket becomes insignificant.

Among steam engine experiments directed specifically to determine the action of the cylinder walls, those of the late Mr. Willans should be specially mentioned. Mr. Willans' death is to be deplored as a serious loss to the engineering profession. His steam engine experiments, some of them not yet published, are models of what careful experiments should be. They are graduated experiments designed to indicate the effect of changes in each of the practically variable conditions of working. They showed a much greater variation of steam consumption (from 46 to 48 lbs. per indicated horse power hour) in different conditions of working than, I think, most practical engineers suspected, and this has been made more significant in later experiments, on engines working with less than full load. The first series showed that in full load trials the compound was superior to the simple engine in practically all the conditions tried, but that the triple was superior to the compound only wher certain limits of pressure and speed were passed.

As early as 1878 Prof. Cotterill had shown that the action of a cylinder wall was essentially equivalent to that of a very thin metallic plate, following the temperature of the steam, the exceedingly rapid dissipation of heat from the surface during exhaust especially being due to the evaporation of a film of water initially condensed on its surface. In permanent *régime* the heat received in admission must be equal to that lost after cut off. In certain conditions it appeared that a tendency would arise to accumulate water on the cylinder surfaces, with the effect of increasing in certain cases the energy of heat dissipation. Recently Prof. Cotterill has been able to carry much further the analysis of the complex action of condensation and re-evaporation in the cylinder, and to discriminate in some degree between the action of the metal and the more ambiguous action of the water film. By discarding the less important actions, Prof. Cotterill has found it possible to state a semi-empirical formula for cylinder condensation in certain restricted cases which very closely agrees with experiments on a wide variety of engines. It is to be hoped that, with the data now accumulating, a considerable practical advance may be made in the clearing up of this complex subject. There are, no doubt, some people who are in the habit of depreciating quantitative investigations of this kind. They are as wise as if they recommended a manufacturer to carry on his business without attending to his account books. Further, the attempt to obtain any clear guidance from experiments on steam engines has proved a hopeless failure without help from the most careful scientific analysis. There is not a fundamental practical question about the thermal action of the steam engine, neither the action of jackets or of expansion or of multiple cylinders, as to which contradictory results have not been arrived at, by persons attempting to deduce results from the mass of engine tests without any clear scientific knowledge of the conditions which have effected peculiar results. In complex questions fundamental principles are essential in disentangling the results. Interpreted by what is already known of thermodynamic actions, there are very few trustworthy engine tests which do not fall into a perfectly intelligent order. There is only one known method, not now much used, by which the cylinder condensation can be directly combated. Thirty years ago superheating the steam was adopted with very considerable increase of economy. It was likely that it was thought by the inventor of superheating that an advantage would be gained by increasing the temperature range. If so, his theory was probably a mistaken one. For the cooling action of the cylinder is so great that the steam is reduced to saturation temperature before it has time to work; but the economy due to superheating was unquestionable, and was very remarkable considering how small a quantity of heat is involved in superheating. The heat appears to diminish the cylinder wall action so much as almost to render a jacket unnecessary. The plan of superheating was abandoned from purely practical objections, the superheaters then constructed being dangerous. Recently superheating has been tried again at Mulhouse by M. Meunier, and his experiments are interesting because they are at higher pressures than in the older trials with a compound engine. It appears that even when the superheater was heated by a separate fire there was an economy of steam of 25 to 30 per cent. and an economy of fuel of 20 to 25 per cent., and four boilers with superheating were as efficient as five without it.

It may be pointed out as a matter of some practical importance that if a trustworthy method of superheating could be found, the advantage of the triple over the compound engine would be much diminished. For marine purposes the triple engine is perfectly adapted. But for other purposes it is more costly than the compound engine, and it is less easily arranged to work efficiently with a varying load.

There does not seem much prospect of exceeding the efficiency attained already in the best engines, though but few engines are really as efficient as they might be, and there are still plenty of engines so designed that they are exceedingly uneconomical. The very best engines use only from 12 to 13 pounds of steam per indicated horse-power hour, having an absolute efficiency reckoned on the indicated power of 16 per cent., or reckoned on the effective power, 13 per cent. The efficiency, including the loss in the boiler, is only about 9 per cent. But there are internal furnace engines of the gas-engine or oil-engine type in which the thermal efficiency is double this.

In his interesting address to this section in 1878, Mr. Easton expressed the opinion that the question of water-power was one deserving more consideration than it had lately received, and he pointed to the variation of volume of flow of streams as the principal objection to their larger utilization. Since that time the progress made in systems of transporting and distributing power has given quite a new importance to the question of utilization of water power. There seems to be a probability that in many localities water power will, before long, be used on a quite unpredecented scale, and under conditions involving so great convenience and economy that it may involve a quite sensible movement of manufacturers toward districts where water power is available.

Let me first point out that water power, where it is available, is so much cheaper and more convenient than steam power that it has never been quite vanquished by steam power.

I find, from a report by Mr Weissenbach, that in 1876 70,000 h. p. derived from waterfalls were used in manufacturing in Switzerland. According to a census in 1880, it appears that the total steam and water power employed in manufacturing operations in the United States was 3,400,000 h. p. Of this 2,185,000 h. p., or 64 per cent., was derived from steam, and 1,225,000 h. p., or 36 per cent., from water. In the manufacture of cotton and woolen goods, of paper and of flour, 760,000 h. p. were obtained from water, and 515,000 h. p. from steam. If statistics could be obtained from other countries, I believe it would be found that a very large amount of water power is actually made available. The firm of Escher Wyss & Co., of Zurich, have constructed more than 1,800 turbines of an aggregate power of 111,460 h. p.

With a very limited exception all the water power at present used is employed in the neighborhood of the fall where it is generated. If means were available for transporting the power from the site of the fall to localities more convenient for manufactures, there can be no doubt that a much larger amount of water power would be used, and the relative importance of water and steam power in some countries would probably be reversed. It is because recent developments seem to make such a transport of power possible without excessive cost and without excessive loss, that a most remarkable interest has been excited in the question of the utilization of water power. Take the case of Switzerland, for instance. At the present time Switzerland is said to pay to other countries £800,000 annually for coal. But the total available water power of Switzerland is estimated at no less than 582,000 h. p., of which only 80,000 are at present utilized. I found a year ago that nearly every large industrial concern in Switzerland was preparing to make use of water power, transported a greater or less distance. Besides the great schemes actually carried out at Schaffhausen, Bellegarde, Geneva and Zurich, where water power is already utilized on a very large scale, there is a project to develop 10,000 h. p. on the Dranse, near Martigny.

Hence it is easy to see that problems of distribution of power—that is, the transformation of energy into forms easily transportable and easily utilizable—have now a great interest for engineers.

Besides the power required for manufacturing operations, there is a steadily increasing demand for easily available mechanical energy in large towns. For tramways, for lifts, for handling goods, for small industries, for electric lighting, and sometimes for sanitation, power is required. Hitherto steam engines, or more lately gas engines, have been used, placed near the work to be done. But this sporadic generation of power is uneconomical and costly, especially when the work is intermittent; the cost of superintendence is large, and the risk of accident considerable. Hence attention is being directed to systems in which the mechanical energy of fuel or falling water is first generated in large central stations, transformed into some form in which it is conveniently transportable and capable of being rendered available by simpler motors than steam engines.

Just as in great towns it has become necessary to supersede private means of water supply by a municipal supply; just as it has proved convenient to distribute coal gas for lighting and heating, and to provide a common system of sewerage, so it will probably be found convenient to have in all large towns some means of obtaining mechanical power in any desired quantity at a price proportionate to the quantity used, and in a form in which it can be rendered available, either directly or by simple motors requiring but little skilled superintendence.

Telodynamic Transmission.—First, then, let me say a few words as to modes of distributing power which it is possible to adopt. In 1850, at Logelbach, in Alsace, M. Ferdinand Hirn used a flat steel belt to transmit power directly a distance of eighty metres. Subsequently a wire rope was used on grooved pulleys. This worked so well that a second transmission to a distance of 240 metres was erected. The details of the system were worked out with great care with a view to securing the least cost of construction, the least waste of energy, and the greatest durability of the ropes. So successful did this system of telodynamic transmission prove that within ten years M. Martin Stein, of Mulhouse, had erected 400 transmissions, conveying 4,200 h. p., and covering a distance of 72,000 metres.

Just at this time a very able and far-seeing manufacturer at Schaffhausen, Herr Moser, had formed a project for reviving the failing industries of the town by utilizing part of the water power of the Rhine; Hirn's system of wire rope transmission rendered this project practicable. The works were commenced in 1863. Three turbines of 750 h. p. were erected on a fall which varies from 12 to 16 feet, created by a weir across the river. From the turbines the power is transmitted by two cables, in one span of 392 feet, across the river. Similar cables distribute the power to factories along the river bank. In 1870 the transmission extended to a distance of 3,400 feet. Power is sold at rates varying from £5 to £6 per horse power per annum. In 1887 there were 23 consumers of power paying a rental of £3,500 per annum for power. The project has been financially successful and is still working. At Zurich, Freiberg, and Bellegarde there are similar installations, and a large scheme of the same kind has recently been carried out at Gokak in India. Wire rope transmissions are of great mechanical simplicity, and the loss of power in transmission is exceedingly small. They are extremely suitable for certain cases where a moderate amount of power has to be transmitted a moderate distance to one or to a few factories. On the other hand they become cumbrous if the amount of power transmitted exceeds 600 or 1,000 h. p. The wear of the ropes, which only last a year, has proved greater than was expected, and is a source of considerable expense.

The practical introduction of a system of distributing power by pressure water is due to Lord Armstrong. Such a system involves a central pumping station, a series of distributing mains and suitable working motors. From its first introduction the peculiar advantages of this system for driving intermittently working machines, such as lifts, dock machinery, railway cranes and hauling gear, became obvious. But, with intermittent working machines, there arose the need of an appliance for storing energy during periods of minimum demand and restoring it in periods of maximum demand. The invention of the accumulator by Lord Armstrong made the system of hydraulic transmission a success, and at the same time fixed its character as a system specially adapted for those cases where intermittent work is required to be done. Lord Armstrong's system of hydraulic distribution by water at a pressure of 700

* Presidential address Section G, British Association, Edinburgh meeting (slightly condensed).

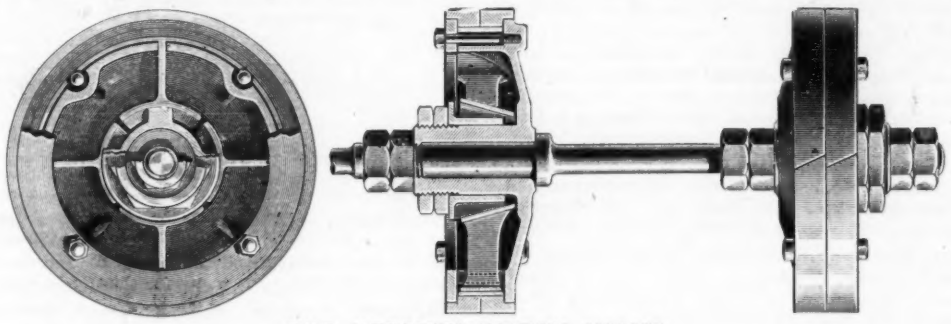
or 800 lbs. per square inch, with the use of accumulators for equalizing the variations of supply and demand, has now been widely adopted. The most extensive scheme of that kind hitherto executed is the important scheme carried out by the Hydraulic Power Company. Over fifty miles of pressure mains have now been laid in the streets of London. The Falcon Wharf pumping station contains four sets of compound pumping engines, each of 200 h. p. Two additional pumping stations have now been erected, and 1,500 lifts are worked from the pressure mains. The minimum charge for water is 2s. per 1,000 gallons. This rate of charge is economical for such machines as lifts, but it would be extravagant for machines working continuously. It would be equivalent to a charge of nearly £50 per horse power per year of 3,000 working hours, apart from interest and maintenance of machines.

The Hershey Adjustable Piston Valve.

The accompanying illustration represents a new form of piston valve which has recently been patented by Mr. M. E. Hershey, of Harrisburg, Pa. These valves have been placed in a number of Ide and Ideal engines of various sizes manufactured by the Harrisburg Foundry and Machine Works, and with very satisfactory results. A solid and chilled piston valve, working in hard cages, all accurately ground, makes an excellent valve, and is practicable in small sizes. By the use of a packing ring it has also proved fairly satisfactory in larger sizes, but many objections can be raised against it. The primary object of this improved construction is to provide a piston valve which shall be capable of rigid adjustment to compensate for wear, whereby the adjustment is maintained throughout the stroke of the valve, and while subjected to peripheral pressure in passing over the ports. A further object is to provide a valve which, when the parts are cooled, will contract and prevent sticking or injury to wearing surfaces, as for instance when the engine is started after a period of rest.

To accomplish this an adjustable sectional spider is introduced, as shown in the cut, of composition metal or brass, having greater range of expansions than the metal in the valve proper or its seat.

Live steam is admitted between the valve discs and the adjustment made when hot, the normal working condition.

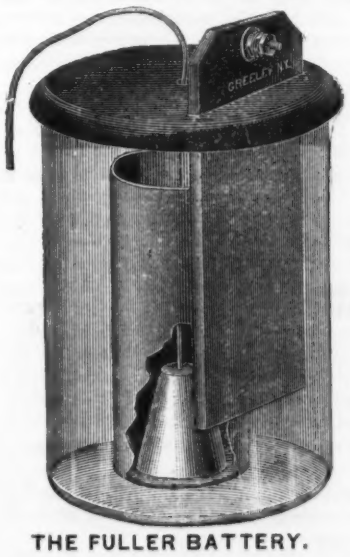


THE HERSHEY PISTON VALVE.

When steam is stopped off from the valve and the parts cool, the sectional brass spider contracts to a greater extent than the balance of surrounding metals, and releases the packing rings, leaving them entirely free in their seats. When steam is admitted, the expansion of the spider being proportionately greater, the valves necessarily quickly assume their original adjustment.

The general construction is shown in the cut. It will be observed that the peripheral adjustment to compensate for wear does not affect any other adjustments for steam distribution.

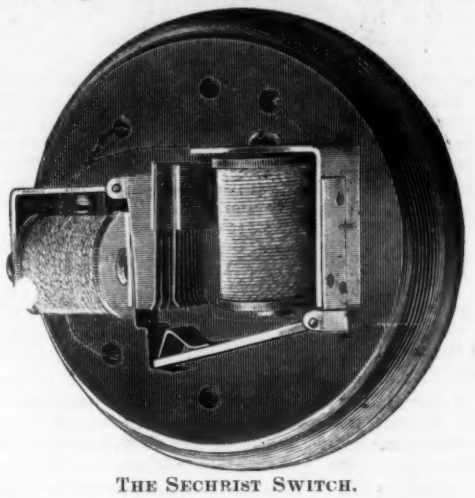
By this construction a valve is obtained that is claimed to be absolutely tight, perfectly balanced, and practically frictionless. The valve being adjustable, these conditions can be maintained to a greater degree than is possible in the ordinary form. The valve is light and consequently any form of automatic governor gives better regulation. The adjustment can be made by any attendant and requires no skilled labor. Waste of steam and the frequent renewal of the parts are obviated, and the expense of maintenance consequently decreased.



THE FULLER BATTERY.

The Sechrist Automatic Switch.

A new form of the Sechrist automatic switch is shown in the accompanying illustration. The switch is constructed on a porcelain base, with a metal cover, and the material and workmanship are excellent. Simplicity is one of its prominent features. The Sechrist automatic switch is quite a development from the old method of controlling lights. Instead of controlling the switches by hand they are controlled automatically by means of push buttons. The switches can be operated either by an ordinary battery, or, if a rheostat is used, by means of a shunt from an electric light circuit. These automatic switches controlling the various lights in a house are all located in some



THE SECHRIST SWITCH.

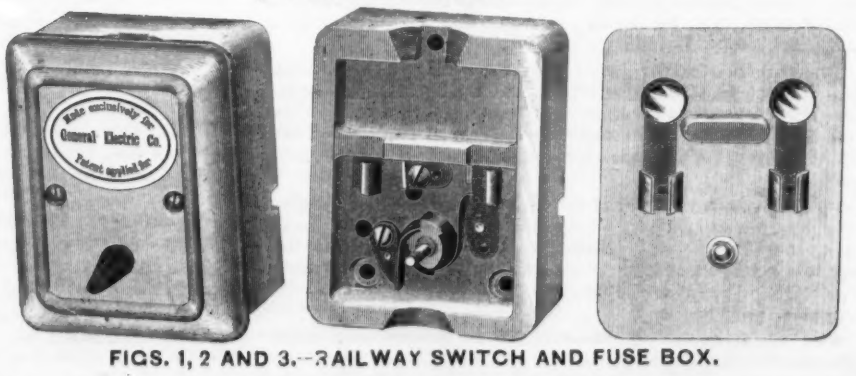
out of the way place where they cannot be seen, and only the neat and ornamental push buttons appear on the wall at the places from which it is desired to control the light. Any number of push buttons may be located at different points to control the same switch. For convenience two push buttons are used to control one light, one being white and the other black. The white button operates the switch which turns on the light and the black button by means of the same switch turns it off. By having banks of buttons located at different points a person moving about the house need never be in the dark, for by simply touching a button he can turn on the lights ahead of him and extinguish those behind. The hall lights may be turned on or off from the first, second or third story, or from any chamber. This system admits of a great range of flexibility in the control and arrangement of lights in private residences. It has also proved very valuable in its application to burglar alarms, as the light can be automatically turned on to the utter confusion of the burglar.

Combined Switch and Fuse Box for Railway Lighting Circuits.

The accompanying cuts illustrate a very neat combination switch and fuse box for use on the lamp circuits of electric street railway cars.

Fig. 1 shows the box complete with the switch handle in place, Fig. 2 shows the body of the box with the rotating ratchet switch in the lower compartment, and Fig. 3 the reverse side of the cover with the terminals and thumb screws for the metal fuse.

This box is claimed to have many advantages over anything heretofore in use for railway lighting service. It is very compact, neat, and as it is made entirely of porcelain, perfectly incombustible.



FIGS. 1, 2 AND 3.—RAILWAY SWITCH AND FUSE BOX.

The switch is of the latest improved type of rotating ratchet switch manufactured by the General Electric Company, and possesses the essential points of good contact and sudden break. The fuse is placed on the inside of the cover, so that in replacing a blown-out fuse the fuse terminals are taken completely out of the circuit, and it is utterly impossible to receive a shock in any way. The brass clips on the cover fit over the two contact posts in the box, and serve the double purpose of holding the cover in place and forming part of the circuit.

As will be seen in Fig. 2, the box is divided into two parts, the lower holding the switch and the terminals for the wire, and the upper part consisting of a shallow recess into which the thumb screws on the inside of the cover project. In the back of the box, behind this upper recess, is a magnetic blow-out, which breaks the arc formed when the fuse is blown.

The Fuller Battery.

The cut on this page illustrates what is claimed to be one of the best telephone batteries yet devised for general service. It is especially adapted for use in cities where telephones are almost constantly in use and on long distance lines over which extended conversations are held. Much attention has been given to this form of battery by some of the largest telephone companies in this country, and it is said to give excellent satisfaction.

The main features of this type of the Fuller battery are its high efficiency, duration and uniformity of strength. Messrs. The E S. Greeley & Co., 5 and 7 Dey street, New York, are placing it on the market.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK AND BOSTON, Aug. 13, 1892.

New York Financial Review.—The market during the week under review has exhibited a little more life than in previous periods during the past month. Its features were the crop report, showing a decrease in corn and wheat, and having a bullish effect upon grain and a bearish effect upon stocks; the advance in the industrials and the bear rates on the market, led by the selling of silver certificates, which reached 82½, lowest price known. Values as a rule have declined, and should conditions be favorable next week a fall market will be started. There has been large buying of commercial paper at 3¼ to 4. Aside from the efforts to make time loans on the industrials, there has not been much demand for funds. Rates West, except at Chicago, are generally about 6 per cent. New York Exchange is at a discount at Chicago, St. Louis, Cincinnati and Kansas City. It continues at par at nearby cities and at the Northwest. In the South it is at a premium.

New York Electric Stocks —The general market was so split up with conflicting conditions that very little attention was paid to those stocks which gave but little prospect of immediate returns. As a result the 20 or 30 securities in the accompanying list were, with the exception of five or six, almost completely ignored. These specialties will be treated under separate heads. Of the other stocks American District Telegraph weakened one point, being bid 61½ and held at 62½. Commercial Cable received a number of bids at 167½ and held at 163; no transactions resulted.

Boston Electrics.—The electric stocks, as also the other industrials, have successfully withstood the influences of the bears, and show only a retarded progress and not one entirely checked by the strong manipulators. General Electric common stock has again been the feature in both New York and Boston. Large sales have been recorded, and it is known that it is bought for investment purposes, by strong holders. It reached its highest point of 116¾ on Wednesday, showing a net advance of almost two points over last week's highest sales. Interest in its further progress has for a time, at least flagged, but only because of a general inactivity throughout the market Prominent bankers continue to predict 150 for the stock this winter. The preferred is quiet at 120. The debenture bonds have sold up to 103¾ Detroit Electric stock is evidently preparing for higher figures, and has already made an advance on quite active sales. All reports from the company will support an attempt to raise the market price, and no doubt there is intrinsic value in the stock at a much higher figure, which it promises to reach on a good market. Thomson-Houston Series D have made an unusual advance of a dollar per share. A dividend is soon due on this stock. Westinghouse common touched 30 once more on small sales. This is simply a response to a movement throughout the list of electrics. Bell Telephone is unusually quiet, and strong as well, with sales at 205.

Western Union —This stock led a remarkably active week at increased values, the opening on Monday being at 96¾ and closing to-day at 98⅞. The transactions were started by Lawson & Co., and augmented by numerous "points" that it was good for 110. Buying this week was doubtless prompted by the belief that the movement was being promoted by insiders for the purpose of placing stock at par. Goodbody & Co., one of the largest houses in the street, said in their circular as follows: "We believe that the dividend is likely to be increased to six per cent. or a stock dividend of perhaps 15 per cent paid, the dividend continued at the five per cent. rate. Still Western Union can no longer be called cheap." The active trading in the bonds of this company, so prominent during the past two weeks, were almost *nil* during the period under review. A small lot of collateral trust 5's which sold at 105 and a second lot of debenture 7's, '75, at 111½ comprised the list.

General Electric.—From the closing last week at 115, the same being an advance of 6 points, the stock under active buying advanced to 119⅞ and closed very strong with prospects of higher values next week. It is very difficult to find a bear in this stock. Every one speaks highly of it and numerous are the prophecies that it will reach 120 within a short time. The buying orders are bringing out stock purchases around 107 to 110. When this stock is shaken out there will be a scarcity that is going to materially advance quotations. The activity in the stock induced very extensive bond buying. Debenture 5's were in good demand, $100,000 selling from 104 to 104¾. A director of the company says that it is earning more than its dividends show. It is now paying 8 per cent. That these are sufficient reasons for the advance, we obtained the following from an authority: "The financial prospects of the consolidated electric companies have never been better than since the amalgamation. Prior thereto they were compelled to do business at a very heavy expense, owing to competition which necessitated the assistance of large business forces and cutting of prices. Under the new order of things, this expensive business operation and loss of profits has to a large degree disappeared. At the same time prices have not been increased, neither is it the policy of the management to advance them. The electric industry has enjoyed development during the last year, a large share of which falls directly to the lot of the General Electric Company. These conditions, coupled with a growing confidence on the part of the public as to the utility of electricity in economics and its consequent enlarged uses, has brought the stock to general notice in a way to show its value. It is paying 8 per cent. and is earning considerably more. The logical conclusion based upon existing conditions is that it will continue to increase in price. From this standpoint, the present quotation is not at all exorbitant and it is likely to be one of the favorite industrial stocks of the list. The present advancement started with the

payment of the first quarterly dividend and has been steady. The fact that F. L. Ames, T. Jefferson Coolidge, J. Pierpont Morgan, D. O. Mills and H. McK. Twombly are prominently identified with the company ought to command the highest degree of public confidence for its securities."

Edison Electric Illuminating.—The activity in this company's securities lay in the bonds. The debenture firsts were in good request, $75,000 selling at 106 to 106¼. Two lots of the general 5's sold at 100⅛ and 100⅜ respectively. The stock on limited sales advanced from 91⅛ on Tuesday to 99 on Friday. Next week this company will make application for the listing of $400,000 of stock now in the treasury, making a total on the New York Stock Exchange of $5,800,000.

Westinghouse.—The company's first preferred seven per cent. cumulative stock sold Wednesday for the first time in several weeks at 93½, and subsequent sales Thursday brought it up to 95. Mr. George Westinghouse is reported as saying that the company was doing a business of between $1,800,000 and $2,000,000 net for the year. Net earnings of $2,000,000 would pay all fixed charges, seven per cent. on the preferred, seven per cent. on the common and leave a balance of $1,261,000. The lowest estimates are that the company is earning 15 per cent. on its entire capital.

North American.—In sympathy with Northern Pacific, of which it is a large owner, North American declined from 14¼ on Monday to 13⅛ to-day. Its assets are largely made up in securities of other companies, and in a fluctuating market its stock acts as a sort of barometer. Concerning the affairs of this company we obtained the following statement from an officer: "The condition of North American has materially improved since the annual report of May last. Contributing to this result are the enhanced market values of the securities held by the company and the rapid growth and profitable development of electrical enterprises in which it is largely engaged. The Milwaukee street railway system is being pushed to completion and showing most satisfactory results, but will not be finished until 1893. The Cincinnati electric lighting and power plant is practically completed and its business is steadily and profitably growing. The first section of the city's street lighting, under the company's recent eleven-year contract, will be in operation during the autumn and the lighting system in the near future. These will largely and constantly augment the company's revenues. The practical tests of electric motors designed for use on ordinary standard railroads are soon to be made, it is stated, at Chicago, on the Chicago & Northern Pacific Belt Line, which is the terminus of the Wisconsin Central and Northern Pacific lines in Chicago, and is largely owned by the North American Company. In this direction the North American Company has recently secured control of other devices and appliances which will largely enhance the importance and value of its electrical interests." The Philadelphia Traction Company has decided, it is stated, to adopt the electric motors of the Westinghouse system, and has awarded the contract for the building of same.

The Electric Street Railways of Lynn and Salem are being brought under one management by a powerful syndicate of New York and Philadelphia parties, who have for some time past been quietly buying up certain properties. The combination includes the Naumkeag Street Railway, of Salem, the Lynn Belt Line, and probably the Lynn & Boston Railway. The latter company alone operates over 90 miles of track between Lynn and Boston and adjacent points; $180 per share is asked for this stock, and the high price may exclude it from the combination. The Naumkeag road connects Salem, Peabody, Marblehead, Beverly and numerous other small towns, and is one of the finest street railway properties in the State. President Breed, of the Lynn & Boston road, is named as general manager of the entire system. Nearly all of the mileage is either operated by electricity or being rapidly equipped for this purpose.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Aug. 13, 1892, and the range for the week in New York, Boston and Chicago:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel....	100	3,825,000	..	....	61½	62½
American Tel. & Cable..	100	14,000,000	....	....	87	88
Central & So. Am. Tel....	100	6,000,000	....	....		
Commercial Cables.....	100	7,716,000	....	....	157½	163
Gold Stock & Tel	100	5,000,000	..	....	100	103
Bonds.....	500	500,000	....	....	100	..
Postal Tel. & Cable.....	..	10,000,000	...	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	86,199 852	96¾	98⅝	97⅞	98
Real estate bonds.....1,000		1,219,000	....	....	....	..
Debenture bonds.....1,000		4,920,000	....	111½	....	..
Collateral Trust 5's....1,000		8,181,000	....	105	....	.
North American.....	100	39.767,200	13¼	14½	....	....
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.,....	100	6,500,000	94½	99	96	99
Edison El. Il. of Brooklyn.	100	750,000	...	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston... ...		.....	....	....	115	125
Edison El. Lt. Europe....1,000		2,000,000	....	....	2	6
Edison General, 5's..... ...		.....	100⅝	100¼	...	.. .
" " 1sts.		.....	105¾	106½	...	.. .
" Bonds.....		30,000	....	. ..	65	80
Edison Ore Milling Co.... ...		2,000,000	....	....	15	20
East River El Light.....	100	1,000,000	....	....		65
General Electric 1,000		50,000,000	114⅜	116⅞	114¾	115
Debenture 5's		.....	104½	104½	..	....
Automatic Exhibition Co. ...		2,500,000	.. ..	....	3	5
Mt. Morris Electric..... ...		500,000	....	....	....	65
N. E. Phonograph.....		2,000,000	....	....	2	4
N. Y. Phonograph		2,000,000	....	....	2	5
North American Phonograph..... ...		2,000,000	....	....	4	6
Westinghouse Elec. & Mfg. Co. 1st p. 7 per cent. Cum.	50	3,717,253	93½	95	....	....
E. & M. Co. Assg.....	50	5,038,116	....	....	....	..

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	9	....	8½	9
Thomson-Houston Elec.—Series D	sh	120,000	8¾	8⅝	8¾	9
Thomson Elec. Weld.. ...	100	1,000,000	....	....	....	40
Thomson European Elec. Weld.....	100	1,500,000	....	....	10	12
Westinghouse Elec.—New Com.	..	6,000,000	30	28¾	29⅞	30¼
Westinghouse Elec.—Pfd. ..		4,000,000	47½	46	47¼	47¾
General Electric.		30,067.200	116¾	114	115½	116
" " Pfd		4,136,300	120	119	119½	120
Fort Wayne Elec.....	25	4,000,000	12⅝	....	12½	13
Fort Wayne Elec.—Ser. A.	sh	80,000	8	....	7¾	8
Detroit Elec	10	750,000	7⅞	7⅛	7⅛	7¼
West End St. Ry. Co.—Com	50	7,150,000	74⅝	73⅞	73¾	74
West End St. Ry. Co.—Pfd	50	6,400,000	88	87	87½	87¾
American Bell Tel	100	15,000,000	205	203½	204	204½
Erie Tel. & Tel. Co..... ..		4,800,000	47	45½	....	45⅝
Mexican Tel. Co..... ...	10	1,280,000	1.07¼	....	1.05	....
New Eng. Tel. & Tel. Co..	..	10,304,600	56½	....	56	56½
Tropical Tel. Co.....	10	400,000	....	....	....	20c.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago, ex rights...	210	..	Chicago Arc Light & Power Co.....	98	99
Central Union.....	57	58	Chicago Edison Co..	170	..
Iowa Union.....	20	25			
Michigan	90	95			
Missouri & Kansas..	56	60			

The Cohasset, (Mass.) Electric Light Company made the following statement of its condition at its annual meeting Aug. 1: Capital, $30,000. Assets: Land and water power, $200; buildings, $4,021; machinery, plant, etc., $33,829; cash and debts receivable, $477; merchandise, etc, $278. Total, $38,807. Liabilities: Capital, $30,000; debts, $7,691; profit and loss, $616; reserved for depreciation, $500. Total, $38,807. The following officers were chosen: President, Amos A. Lawrence; secretary and treasurer, Edward F. Ripley; directors, Amos A. Lawrence, Edward F. Ripley, Silas Pierce, John C. Howe, Lyman B. Willcut, Charles A. Welch.

Copper Market.—Eleven and a half cents is being freely bid for lake copper by broker's consumers, and is being equally as universally refused by the companies. Sales were made this week at 11⅝ cents, which figure can be considered the market. The movement of stock is quite free, and is going mostly into the hands of manufacturers of electrical apparatus. The exports are nil, except for matte, of which 1,074,000 lbs. were sent out from this port last week. The companies claim that 11¾ cents is the lowest figure at which they will sell lake copper, and should they adhere strictly to this determination the fall market, which promises to be fairly active, will be on a higher basis than at present.

NEW INCORPORATIONS.

The Berwick Electric Light Company, of Berwick, Pa., capital stock $25,000, has been formed to furnish light by electricity. Fred H. Eaton, B. F. Crispin, Jr., and S. H Watts are the incorporators.

The Four Lakes Light and Power Company, of Madison, Wis, capital stock $50,000, has been formed to construct and operate an electric plant. The promoters are J. Alford, G. H. Shaw and J. Lamont.

The Bellevue Light and Power Company, of Pittsburgh, Pa, capital stock $1,000, has been formed to supply light, heat and power to that town, etc. S. L. Roseburg, F. B. Fuistwait and Jos. P. Beggs are the promoters.

The People's Electric Company, of Braddock, Pa, has applied for a charter. The incorporators are: J. Vance, A. T. Reid, D. D. Wilson, E. J. Snail, S. D. Hamilton, A. M. Carline, J. K. Mills and L. E. Baker. The capital is $75,000.

The Red Cloud Power Company, of Red Cloud, Neb., capital stock $60,000, has been formed to generate and furnish electric current, etc. U. S. Garber, G. G. Yeiser, and P. A. Beacley, of Red Cloud, Neb., are the incorporators.

The Charleroi Heat, Light and Power Company, of Charleroi, Pa., capital stock $5,000, has been formed to supply heat, light and power by electricity to the Charleroi. J. W. Coyl, E. B. Gawthrop, and James R. Ryan are the incorporators.

The Portland Gas Company, of Portland, Ore., capital stock $1,000,000, has been formed to manufacture and sell electricity for light, fuel, power, etc. A. L. Mills, C. H. Lewis, Henry Farling and C. A. Dolph, all of Portland, are the incorporators.

The American Electric Enamelite Company, of Chicago, Ill., capital stock $250,000, has been formed to manufacture, buy and sell electric heating apparatus, etc. O. H. Olsen, J. S. Cummins, J. Scribner and J. H. Livsey are the incorporators.

The Missouri Water and Light Company, of Kansas City, Mo, capital stock $2,000, has been formed to furnish the city and citizens of Carrolton, Mo., with water, gas and electricity. The promoters are A. K. Stilwell, A. A. Mosher and R. B. Cone.

The Titusville Electric Light and Power Company, of Titusville, Pa., capital stock $100,000, has been formed to supply light, heat and power by means of electricity to that town. Frank R. Dravo, Geo. Buffington, and Geo. H. Fox are the incorporators.

The Electric Current Regulator Co., of Manchester, N. H., capital stock $40,000, has been formed to manufacture and sell devices for regulating electric currents, with A. J. Hodder, F. C. Twombley, C. M. Floyd, John Gay and E. A. Stratton as incorporators.

The Burlington Electric Lighting Company, of Burlington, Ia., capital stock $150,000, has been formed to equip and operate a lighting and power plant in Burlington, Ia., Frank G. Jones, Josiah Stedman and E. C. Walsh, all of Burlington, are the promoters.

The E. C. Bernard Company, of Troy, N. Y., has been incorporated with a capital stock of $15,000, to manufacture and use electrical and other machinery. Edgar C. Bernard, K. P. Dowsley, both of Troy, and Frank L. Stevens, of North Hoosick, N. Y., are the incorporators.

The Columbus Gas Company, of Columbus, O., capital stock $1,500,000, has been formed to manufacture and sell appliances for the conveyance of electric currents. Philip H. Bruck, Wm. Y. Miles, N. B. Abbott, Allen W. Thurman and Chas. G. Lord are the promoters.

The Philadelphia & Bryn Mawr Passenger Railway Company, of Philadelphia, Pa, capital stock $50,000, has been formed to construct and operate an electric railway in that city and vicinity James Jarden, Jr., Chas. F. Trego and Adolph Hermann are the promoters.

The Elmwood and Fairmount Park Passenger Railway Company, of Philadelphia, Pa., capital stock $50,000, has been formed to construct and operate an electric street railway in Philadelphia. The promoters are James Jarden, Jr., Charles F. Trego and Adolph Hermann.

The Puritan Mining and Milling Company, of Philipsburg, Mont., capital stock $1,500,000, has been formed to operate electric power plants, supply electricity, operate telegraph and telephone lines, etc. John McKechney, Frank E. Corbett and John McKechney, Jr., are the incorporators, and are residents of Butte, Mont.

The Portland General Electric Company, of Portland, Ore., has been formed with a capital of $4,250,000, to carry on and conduct the business of generating, making, transmitting, furnishing and selling electricity for the purpose of lighting and power. P. F. Morey, Frederick V. Holm and C. H. Canfield are the incorporators.

The Burlington & Mount Holly Connecting Company, of Burlington, N. J., capital stock $100,000, has been formed to transport goods, passengers, etc., between the two cities named by means of an electric or other railway. C. H. Goebel, Philadelphia; W. H. Clough, of New York; G. Morris, Jersey City, N. J., are the promoters.

AFFAIRS OF THE COMPANIES.

The Vermont Electric Company has purchased the land and water privilege at the gorge of the Winooski River for $1,935. A plant to cost about $60,000 will be erected at once.

The Albany Railway threaten to abandon the Broadway line in the village of Greenbush if the intention of the village authorities to pave the street with asphalt is carried out.

The Postal Telegraph Company, at the annual meeting of its stockholders, elected the following directors: John W. Mackay, William C. Van Horne, George Stephen, Charles R. Hosmer, Richard V. Day, Albert B. Chandler, Edward C. Platt, George G. Ward and William H Baker.

The Kennebec Light, Heat and Power Company, of Augusta, Me., has closed a contract with the Economic Light and Power Company, of the same place, whereby the latter sells all its rights and privileges, and agrees to withdraw the petition which it now has before the city government.

The Onondaga (N. Y.) Electrical Company, through a committee appointed for that purpose, has chosen a site for its plant at the corner of James and Pearl streets. It is 71 feet front on James street, and extends along Pearl to Canal street. The price paid was $25,000. The cost of the building will reach the same figure.

The Annual Report of the Harlem Bridge, Morrisania & Fordham Railroad Company, of New York City, as filed with the railroad commissioners for the year ended July 30 last, shows gross earnings, $178,646; operating expenses, $161,373; net earnings, $17,272; interest on funded debt, $3,812; taxes, $8,385; cash in hand, $5,564; profit and loss (surplus), $11,481; interest on loans, $1,490; net income, $3,585.

The Hartford Light and Power Company, of Hartford, Conn., which secured the property of the Hartford Steam Company in June, has laid the foundation for its new plant, and the work is progressing rapidly. Two Corliss compound condensing engines with a combined horse power of 3,000 under a steam pressure of 125 pounds will furnish the power. The main shaft will be 156 feet in length, each dynamo being connected with the shaft by means of a clutch pulley The cost of improvements will be about $50,000.

Albany, N. Y.—A certificate of an agreement for the consolidation of the Rochester Gas Company, the Edison Electric Illuminating Company, of Rochester, and the Rochester Electric Light Company has been filed. The name of the new company is the Rochester Gas and Electric Company. The capital is $4,300,000. The following are the directors: J. L. Judson, Frederick Cook, A. H. Harris, G. C. Hollister, G. A. Hollister, H. H. Craig, George W. Archer, and Harry L. Brewster, of Rochester, and William Remple, H. G. Remple, R. A. C. Smith, Theodore F. Wood, and W. E. Stiger, of New York.

Aurora, Ill.—The City Clerk's annual report shows that the municipal electric light plant has been extended during the past year by the addition of one and a half miles of line wire, and ten new lamps. The sum of $6,992.37 has been paid during the year 1891, and is the balance of the expense incurred during the year 1890, in making the large extensions of the plant in that year. The plant now furnishes 128 lights, which have been run during the past year at an expense of $8,313.38, being at the rate of $64.95 per lamp per year, or $5.41 per lamp per month, and the lights have been run 2,980 hours during the past year, which is a daily average of 8 hours, 10 minutes.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Aug. 15, 1892.

J. H. McEwen, president of the J. H. McEwen Manufacturing Company, of Ridgeway, Pa., was in the city on business last week.

Mr. Geo. A. Ford, of the Ford-Washburn Star-electro Company, of Cleveland, O, made THE ELECTRICAL WORLD a pleasant call last week.

Mr. H. J. Harby, general manager of the Cordarelli Electric Light Mast Arm Company, of Sumter, S. C., was in the city last week.

George C. Baillard, formerly with Doubleday, Mitchell & Co., has been appointed assistant foreman of the Union Electric Railway construction department.

F. A. Magee, formerly with the Underwood Belting Company, with headquarters at Boston, is back at his old position as general sales agent with The E. S. Greeley & Co.

The Hall Railway Signal Company (Johnson Department) has been given a contract to equip the Shore Line division of the N. Y., N. H. & H. R. R. with the tower system of signals.

Frank Harrington returned from California last week with a "glorious climate" smile and order for Grimshaw in every pocket. Frank says while he was out there the record was reduced to two minutes.

Mr. J. G. Seixas, formerly with Edison at Orange, and who has been identified with electrical construction work for several years, has accepted the position of assistant superintendent and electrician of the New York Electrical Equipment Company, Duane street, corner of Elm, New York City.

Mrs. S. A. Day, wife of A. G. Day, whose name has been associated with the electrical industry since its incipiency, died at Seymour, Conn., last week. Since Mr Day's death she has conducted the business, so successfully started by him, with unusually good business tact. Mr. W. R. Brixen, who has long been associated with the company as general manager, will without doubt hereafter act as its chief executive. L. H. H.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Aug. 13, 1892.

Mr. Herbert Wadsworth, of the General Electric Company, left for Nashville, Tenn., this week.

Mr. B. A. Arnold is building the Columbian Intra-mural Railway on the World's Fair grounds.

Mr. F. S. Terry, manager of the Electrical Supply Company of Chicago, has left for his summer vacation, and will probably return about the first of September.

The North Shore Construction Company has been incorporated for the purpose of laying an electric road in Waukegan. Dunlap Smith is mentioned for the presidency of the company. Its authorized capital is $50,000.

Mr. F. E. Drake, formerly the Chicago representative of the Rockford Electric Manufacturing Company, and who joined forces with the Standard Electric Company, Chicago, a few weeks ago has recently secured a couple of handsome contracts.

To Enlarge the Plant.—The present power and generating plant of the Cicero & Proviso Electric Railway at Ridgeland, Ill. is to be doubled. A large order for additional rolling stock has also been placed, including 20 motor cars, besides trailers. Several extensions of the road are also contemplated.

Mr. Steele Mackaye, the dramatic author, whose study is located in suite 56, Wabash avenue entrance to the Aditorium, is securing information from the manufacturers of motors and other electric apparatus, prior to calling for bids on twenty motors, as well as for arc and incandescent lighting apparatus.

The Jackson Electric Street Railway Company, of Jackson, Mich., has notified the companies insuring the line that they will make a claim for damages to dynamos caused by lightning on Aug. 1. There was no lightning clause in the form and the company will probably have a hard time collecting the damages claimed.

The Pabst Brewing Company, Milwaukee, Wis., has placed an order for two 2,500-light and one 1,000-light Siemens-Halske machines. These are to be manufactured in this country, and it is reported are the first machines of this type sold in America. These machines are to be coupled direct with the Lake Erie company's compound engines.

New District Messenger Service.—A new district messenger service company has been organized to operate in Hyde Park and neighborhood. The capital stock is fixed at $200,000, and it is understood the company is under the protection of the Postal Telegraph Company. The necessary franchise has been obtained for the work of construction, and pole planting will be commenced at once.

The Calumet Electric Company, of Chicago, is building a double track road on Seventy-fifth street, near the Illinois Central track, under a franchise granted July 25, and the Windsor Park Railway Company has been refused a permit to lay tracks on the same line under an ordinance passed July 14. The Windsor Park Company claims that it ought to have possession of the right of way by virtue of the priority of its ordinance, whereas the Calumet Company assumes that its earlier acceptance of the rights and obligations under the later ordinance gives it all the right to the street.

Chicago Visitors.—Among the out of town visitors to the World's Fair City this week were Mr. P. L. Rose, of the Rose Electric Light Supply Company, St. Louis, Mo; Mr. George Porter, secretary of the National Electric Light Association, en route from New York to St Louis, to confer with President James I. Ayer; Mr. Cyrus O. Baker and wife, Newark, N. J.; General C. A. Barney, of New York, who is looking after his electric launch interests at the World's Fair; Mr. D. B. Dean, en route to Colorado for a vacation in the mountains; Mr. J. F. Cummings, Detroit, Mich., and Mr. C. G. Goodrich, of the Minneapolis Street Railway Company, Minneapolis, Minn.

The Chicago Edison Company proposes to build at Harrison street and the river what will be the largest electric light and power plant in the world. It will cost $1,000,000, a large part of which will be expended in the foundation. The new building will occupy a lot 200 feet square on the east bank of the south branch and the north side of Harrison street. The total horse power of the present plant is about 8,000, but the total horse power of the new plant will be 25,000. It will probably have forty engines and eighty dynamos. The building will cover the entire lot and will be mostly foundation, the whole area to be made solid with piling. The removal of the company from its present location is absolutely necessary on account of the growth in its business. F. DE L.

TACOMA, Wash., Aug. 8.

Sidney, Wash., has given Isaac Nixon a ten years' franchise to construct and operate an electric lighting plant.

The Western Union Telegraph Line, north from Seattle, has been completed to Woolley and connected with the line on the Seattle & Northern railroad. It is now in operation.

The Portland Consolidated Street Railway Company, of Portland, Ore., has filed articles of incorporation, with a capitalization of $1,000,000, at the office of the Secretary of State, in Olympia, Wash.

Joseph L. Colby, of New York, has offered all the capital required for an electric light and electric railway plant for Everett, Wash., taking in return the bonds of the local company which would be formed.

The Union Trunk Line Company, of Seattle, has ordered three more closed cars with removable sides. They will be built by Rohlfs & Schoder and will be used on the company's cable line on James street.

The Tacoma Light, Heat and Power Syndicate has ordered an additional 400-light Edison incandescent dynamo and a 75-h. p. Buckeye engine, to be placed in the power house at the Washington building.

Coulee City, Wash., has been connected by telegraph with Waterville, 35 miles distant. The line will be extended from Waterville to Chelan, Chelan Falls, Port Columbia, Bridgeport, Ruby, Conconnully, Loomis and Golden.

A. F. Espersen, of the Arnold Novelty Company, of Tacoma, has gone to Chicago to open an agency for the Arnold Flexible Bracket. Agencies will also be established in New York and San Francisco. Mr. Arnold is now located in San Francisco.

Seattle City Street Lighting.—Sealed proposals have been advertised for and received by the Seattle Board of Public Works for lighting the streets for one year. The city is to have the right to increase the number of arcs to 150 and of incandescents to 1,000 during the year.

The Grant Street Electric Railway Company's new power house in Seattle is completed. A Thomson-Houston w. p. 90 railway generator is being installed. Also, a 650-light alternating dynamo, Thomson-Houston type, will be placed there to furnish incandescent lights.

The East Side Railway Company, of Portland, Ore., is now running cars regularly to Milwaukee. Two new double-truck cars have been placed on the line. A branch from the Vancouver line, about a mile in length, running east from a point north of Irvington, has been put in operation.

The Seattle Electric Railway Companies have requested the City Council to release them from the condition of their franchises requiring them to furnish lights along their right of way. Another movement is on foot to consolidate the companies, which represent an aggregate investment of $3,600,000. G. R. DE V.

CANADIAN NOTES.

OTTAWA, Aug. 13, 1892.

St. Thomas, Ont., is agitating the question of municipal control of the electric light system.

Montreal.—The Outremont Council is taking steps to secure the extension of the Montreal Electric Street Railway to Outremont.

Guelph, Ont.—The City Council have refused to grant the Waterloo Private Telephone Company permission to erect poles in this city.

Strathroy, Ont.—This town is advocating the construction of an electric tram line along the Mount Brydges road to connect with the Canadian Pacific.

Montreal.—Messrs Harvey P. Dwight, E. Royer, Geo. P. Perry, of Toronto, and Wm. Wainwright, of Montreal, will apply for a patent incorporating them under the name of the Anglo-Provincial Telegraph Company, with a capital stock of $25,000. The principal place of business will be in Montreal.

Brantford, Ont.—The tenders received for the electric lighting of the city by a private company, or by the city itself, were submitted to Mr. Thomson, of Hamilton, an electrical expert. Seven proposed tenders were received from the following companies: The Ball Company, the Reliance Company, Brantford Electric Company, Royal Electric Company, Toronto Construction Company, Edison Electric Company, and Brantford Street Railway Company. He recommended the acceptance of the tenders of the Brantford Electric Company.

Windsor, Ont.—Windsor's electric road has passed into the hands of a receiver. The claim of the Bank of Montreal is $3,000, but the largest creditor is the Third National Bank of Detroit, their claim amounting to nearly $50,000, part of which is secured. The road will be kept running just as if nothing had happened. On the outside it was learned that C. E. Warner and Levi T. Griffin, of Detroit, who, with President Clark, own the road, are really the ones who had a receiver appointed. They claim that under Mr. Clark's management the road has not done near what it ought, and took this method of finding out just how the road stands.

Ottawa, Ont.—The Ottawa Electric Light Company has signed papers with Messrs. Pattee, Perley & Powell, lumber merchants, for the occupancy of a new power house at the Chaudière. The building is to be erected by the firm on the site of its blacksmith shop on the McKay flume, and will cost $18,000 without machinery. Work is to be commenced at once. The building will be stone to be first floor and frame covered with iron above. It will be 116 feet long and 50 feet wide. Arrangements will be made in the flumes for four 60-inch water wheels, though at first only two of the 60-inch wheels and one 58-inch will be used. It is understood the company intends to go into the incandescent light business and supply power for motors in opposition to the existing companies.

Ottawa, Ont.—Commissioner Miall, of the Inland Revenue Department, recommends that a sufficient sum be placed in the government estimates for the purpose of undertaking the preliminary work of inspection of electric lights. It appears that during his recent tour of inspection Mr. Johnson found the managers of gas companies generally complaining of what they claim to be an injustice on the part of the government in compelling gas producers to submit to the inspection of their meters and of the illuminating power and purity of their gas, while electric light companies are allowed to sell their light without government inspection of any kind, either as to its measurement or illuminating power. Consumers are now taking up the question, and for their own protection demand inspection of electric lights.

Brantford, Ont.—This city is now discussing the question of the introduction of an electric light system to be owned and operated under municipal control. The City Council has decided on submitting to the ratepayers a by-law for raising $11,000, to expend on an electric lighting plant. The committee in making up the figures of cost of complete plant based its calculation as to dynamos upon the sizes that will feed at least 80 lamps. These figures are as follows: Two dynamos of 80 lamps capacity, 60 all night lamps, with all accessories and appliances, as enumerated in the tenders, to make the complete outfit $1 800; 75-h. p. compound engine and all connections, $2,500; foundations, say $250; poles, wire, cross-arms, pins, insulators, hangers, etc., erected, $3,236; total, $10,786. For working expenses, etc., the committee estimated: First sinking fund and interest will pay $11,000 in 10 years at 4½ per cent., $1,432.65; fireman, $480; carbons, $360; trimmer, $360; oil and waste, $50; depreciation and repairs, $400; insurance, $30; coal, $1,200; total, $4,312.65.

Ottawa, Ont.—Messrs. Oppenheimer & Burdis, managers and proprietors of the Vancouver & New Westminster (B. C.) Electric Street Railway, the longest line in Canada, who have recently been in Ottawa, state that they have examined the passenger lines in all the chief American cities east of Winnipeg, and their conclusion is that the best equipped road in all the East is that of the Dominion capital. On the Ann street extension a new wrinkle in trolley wires is being tried. The wire is steel instead of copper, like the others, and the trolley wheel is set instead of revolving. The idea of the steel wire is to provide something more durable than copper under the constant friction. To give proper conductivity, the cross wires are copper. The situation is simply being reversed. The steel trolley wire worked well and with less sparking than a copper wire.

Ottawa, Ont.—Work has been commenced on placing the electric machinery in the Ottawa Electric Street Railway Company's new power station at the Chaudière. The chief novelty of the station is that it will be the first building in America to be heated by electricity, although Mr. Peabody, of New York, is pushing for that honor. The method of heating will be very simple and compact. Pits lined with brick will be run underneath the floor, and in these will be placed hot water pipes. The water will be heated by the electrical apparatus patented by Mr. Ahearn. The machinery being placed in position is an immense 400-h. p. generator, manufactured by the Westinghouse Electrical Manufacturing Company, of Pittsburgh. This is the largest generator ever brought into Canada, and weighs in the neighborhood of 33,000 pounds.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, July 20, 1892.

The Liverpool Overhead Railway.—Experimental trains will be running on the Liverpool Overhead Electric Railway early this autumn.

The London-Paris Telephone.—An additional call-office has just been opened in connection with the London Paris telephone trunk wire. The popular favor and financial success which have attended this venture must give rise to strange reflections in the minds of the many pessimists who decried the idea and prognosticated its failure.

Municipal Electric Lighting.—At a recent meeting of the Blackpool Town Council it was decided to spend some £26,000 on an electric lighting scheme. At the same time that the job was put up to tender the post of municipal electric lighting engineer was also put up to tender, that is to say the Town Clerk was instructed to advertise for a suitable man, "applicant to state amount of salary required."

The Lane-Fox Distribution Patent.—The hearing of the appeal in connection with Lane-Fox's patent for parallel distribution with secondary batteries as "reservoirs of electricity" has been concluded, but judgment has not been given. Should Mr. Lane-Fox win his appeal the result will be largely of the nature of a Pyrrhic victory, since the patent expires this October and the Judicial Committee of the Privy Council, owing to some legal lapses on the part of the patentee, has declined to consider the question of its prolongation.

News of the Week.

THE TELEPHONE.

The Chesapeake & Potomac Telephone Company, of Washington, D. C., has requested permission to string a wire from Florida avenue and Eighth street northwest to Takoma Park for the purpose of furnishing telephone service at Takoma Park. The request will be granted.

To Converse Between Paris and New York.—The Boston *Herald* has a dispatch from Paris which says: "*The Figaro* makes the important announcement that the difficulty in working long distance telephones under water has at length been overcome and that it will be possible to converse as easily between Paris and New York as between Paris and Versailles. The discovery by which this great feat can be accomplished is the achievement of a Frenchman, M. Oillot, the inspector of telegraphs in that city. The inventor is fully assured of his success, and has no doubt that his improved telephone will be in complete working order before the end of September."

THE ELECTRIC LIGHT.

Hummelstown, Pa., is to erect an electric light plant.

Newman, Ill.—The electric light plant is advertised for sale.

Hamburg, Pa., will hold a special election Sept. 3, to decide whether electric lights shall be introduced.

The Baker Gun Company, of Batavia, N. Y., has purchased a new dynamo for lighting its factory. The plant will now have a capacity of 1,000 lights.

The Edison Electric Light Company, of New Orleans, is reported to have been purchased by the Fort Wayne Electric Company, of Indiana, for $275,000.

Coatesville (Pa.) Electric Light and Heat Company has purchased the Hunt property and has entered a $1,000 bond guaranteeing to have the city lighted by Jan. 1, 1893.

St. Clair, Pa., has decided to advertise for bids for the erection of an electric light plant, in accordance with the decision at the late election held for that purpose several weeks ago.

Easton, Pa.—The advisability of starting a new electric company in Easton to supply the citizens of Easton, South Easton, and Phillipsburg with arc and incandescent lights is being discussed. Part of the proposed plan is to have the power of the plant furnished by water power from the Delaware River.

THE ELECTRIC RAILWAY.

Plainfield, N. J.—The cars on the new electric street railway have begun to run regularly.

The Jamaica Electric Railroad Company's plant at Woodhaven, L. I., was struck by lightning last week and destroyed by fire. The loss is about $25,000, partially covered by insurance. The destruction of the plant interrupted traffic for a number of days.

Rockland, Me.—The new electric street railway between Rockland and Camden has been put in operation and works with excellent satisfaction. It is intended primarily as a freight road, but will undoubtedly do passenger service, as there is great need for rapid communication between these two cities.

The Lackawanna & Wyoming Electric Transfer Company, of Scranton, Pa., is to apply for a charter to construct an electric road from Scranton to Factoryville, a distance of 16 miles. S. H. Jermyn, B. E. Killiam, J. B. Owens, A. E. Burr and R. H. Holgate are said to be interested in the scheme.

LEGAL NOTE.

The Gamewell Fire Alarm and Telegraph Company, by the recent decisions of Judge Colt, of the United States Circuit Court, Boston, Mass., sustains defeat in three and wins in one of the suits which were brought against it by the Municipal Signal Company. The first suit, which the Gamewell company wins, related to electric signal boxes used in a municipal signal system. The second suit was in reference to an apparatus by which signals are conveyed to a central station from boxes and which simultaneously registers a message, records the time of its reception, and sounds an alarm; the third suit related to a device by means of which the reception of an emergency signal at the main station is marked by the ringing of a bell; the fourth suit also related to an improved form of signal box. The last three suits resulted in decrees for the complainants.

PERSONALS.

Mr. Nelson W. Perry has accepted the position of managing editor of the *Street Railway Gazette*, of Chicago.

Mr. Reginald A. Fessenden has resigned his position with the Stanley Laboratory Company, at Pittsfield, Mass., to accept the professorship of Electrical Engineering at Purdue University, Lafayette, Ind,

Prof. Wm. P. Trowbridge, head of the engineering department of the School of Mines, Columbia College, died at his home in New Haven on Friday, Aug. 12. He was vice-president of the New York Academy of Science and of the American Association for the Advancement of Science.

MISCELLANEOUS NOTES.

Pittsburgh, Ky.—Electric wires are to be buried within four years, at the rate of 25 per cent. each year. The agreement went into effect Aug. 1.

The New Jersey State Electric Subway Commission has given permission to the Passaic & Newark Electric Company to run a line between Passaic and Newark, and has also granted the Peoples' Electric and Power Company permission to erect poles and run underground wires in Jersey City.

The Canadian Electrical Association has published in pamphlet form the proceedings of the first convention, which was held at Hamilton, Ont., June 14, 15 and 16, 1892. The papers read, the discussions and the various reports are given in full. The fact that it is issued so soon after the convention is unusual, and special credit is due to those who had the matter in charge.

Kansas City, Mo., is preparing for a thorough inspection of all buildings equipped with electric light wires. Hitherto the work has been under the charge of the Kansas City Board of Underwriters, but to secure better service the fire department will cooperate. An expert electrician has been appointed inspector. This step has been rendered necessary by the large amount of poor wiring that has been done.

Rapid Mail Service.—An appropriation of $10,000 was recently made by Congress to conduct experiments with electrical devices, pneumatic tubes and other contrivances for the rapid transportation of mails. The tests are to be made at Washington on Sept. 8. It is thought that some system will be adopted, as it would be of great importance between such points as New York and Brooklyn, or New York and Harlem, for instance.

Wreck at the Ogden Mines.—A bad accident occurred at the ore concentration works on last Saturday afternoon. A new building was being erected and the frame, which consists of eighteen sections of heavy unseasoned timber, was being hoisted into position. Just as the last section was going up the guy ropes parted, the section fell over upon the next one and the whole eighteen went down with a crash. Two men were killed outright and two fatally injured. Mr. Edison, who spends much of his time there watching the operations of his magnetic ore separator, was on the spot and superintended the rescue of the victims.

The American Bell Waterphone Co. is the name of a new company which has been incorporated in Chicago with a capital of $1,000,000. H. M. Lewis, C. F. Danderdale and L. T. Hovey are the interested parties. The waterphone, which is claimed to be an invention of Prof. Alexander Graham Bell, is a mechanical telephone, having a diaphragm about three inches in diameter in a large bell-shaped transmitter. The contact is made with a steel pin which has a thread on its external end to which may be attached a sounding rod. If the end of this sounding rod is placed on a water pipe leading into a house the flow of water can be readily detected by the waterphone at any distance away. Water companies will thus be enabled to prevent the waste of water, to locate leaks, etc.

Industrial and Trade Notes.

The Fulton Electric Supply House, of New York City, has removed from 12 Fulton street to No. 35, on the same street.

Hohman & Maurer, of Brooklyn, report large sales of their thermometers and steam gauges, as they are at present furnishing these goods for a number of very large commercial concerns.

The Galvanic Battery Works, manufacturers of measuring and testing instruments, scientific electrical apparatus, office telephones, etc., has removed its offices and factories to larger premises at 115 Wellington street west, Toronto.

The Fitch Battery and Electric Company, of Oneida, N. Y., has received notice that the Perfect Battery, manufactured by them, was used with very gratifying results in connection with the exhibition of the system of the Electric Heat Alarm Company of Boston, recently given in St. John, N. B.

The Northern Gas and Electric Company, 207 Woodbridge Building, Duluth, Minn., which has recently entered the field in electric wiring, the manufacture of electric motors, electric bells and annunciators, gas and electric fixtures, etc., is meeting with excellent success. Mr. Chas. F. Speed is the manager.

The Bryant Electrical Supply Company, of Bridgeport, Conn., manufacturers of electrical specialties for incandescent lighting, has issued a very neat little catalogue containing illustrations of all the specialties handled by them and all the necessary information. This company has met with success in the specialties which it manufactures, as this new catalogue indicates.

A Large Isolated Plant.—One of the handsomest isolated plants being put in at present is that in the power station of the Broadway cable road. The plant will comprise between 3,000 and 4,000 lamps, and quite a number of electric motors. Slow speed dynamos, coupled directly to the engine shaft, will be used. H. Ward Leonard & Co. are acting as the bulk contractors for the entire electrical equipment.

The Union Manufacturing Company, of Battle Creek, Mich., has received the following note from the Armstrong Furniture Company, of Evansville, Ind.: "We were in hopes that our telegram would reach you before shipping the Burnham Fire Pump. Our foundation is laid and the bolts are all placed to suit your pump template. Your pump means a saving to us of almost $200, and then our Frost Pump Boiler Feed is such a success that all told makes us a friend to your pumps.

The Purity Oil Filter Manufacturing Company, 90 Water street, Pittsburgh, Pa., reports the following sales during the first week in August: The Vacuum Oil Company, three orders; San Francisco and San Mateo Street Railway, one No. 2 Ideal oil refiner; the Homestake Mining Company, Lead City, South Dakota, one No. 2 Ideal; Tennessee Manufacturing Company, Nashville, Tenn., one No. 2 Ideal; Marshall, Kennedy & Co., Allegheny, Pa., one No. 4 Ideal; Atwood & McCaffry, Pittsburgh, Pa., one Ideal oil refiner for refining oil used in cutting threads on pipe.

Mr. E. J. Wessels, of the New York office, has recently closed an important order for the Short Electric Railway Company, which he represents. The order covers 30-h. p. single reduction motors and a 100-h. p. generator for the Syracuse, Eastwood Heights & DeWitt Railroad Company, of Syracuse, N. Y. The Short company also furnished the apparatus for the Collins Park & Belt Railroad Company, of Atlanta, Ga., which is now in successful operation with two 150 h. p. generators and ten Brill cars, equipped with 20-h. p. single reduction motors.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

A Most Valuable Addition to an Electrical Library.—Mr. A. H. Johnson, of the Zanesville, O., Street Railway Company, states that he considers Houston's "Dictionary of Electrical Words, Terms and Phrases" "one of the most valuable additions to an electric library one can have. Every one interested in the business should have one."

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

U. S. PATENTS ISSUED AUGUST 9, 1892.

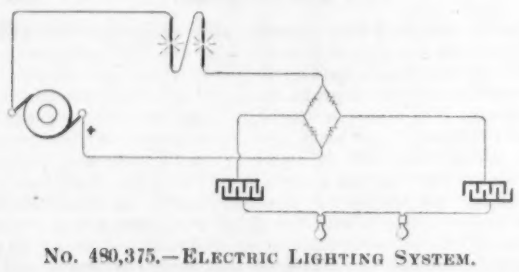
480,266. Secondary-Battery Plate; Edward A. Knowles-Brooklyn, N. Y. Application filed Oct. 15, 1891. A plate for electric batteries composed of an alloy of about eighty-two parts lead, sixteen parts tin, one and nine-tenth parts antimony, and one-tenth part arsenic.

480,284. Incandescent Electric Lamp; Paul Scharf, Vienna, Austria-Hungary. Application filed Aug. 7, 1891. An incandescent lamp consisting of a bulb provided with a neck having two tubular bearings metalized, an incandescible body and supporting and conducting wires therefor, soldered to the inner metalized surfaces of the bearings, and a metallic cap soldered to the outer metalized surface of the bearings.

480,285. Arc Lamp; Charles Schmid, Chicago, Ill. Application filed Dec. 7, 1892. In electric arc lamps, the combination, with the carbon holder and its retaining clamp of a mechanical suspender for the clamp and a trip-feed co-acting mechanically at regular intervals to shift the suspender and release the clamp.

480,319. Electric Bell; George W. Conover, Chicago, Ill. Application filed Oct. 31, 1891. The combination of a base with contact points thereon, and a cover containing the operative portions of the bell or buzzer with opposite contact points, one set of contacts consisting of a hook and an engaging part therefor.

480,340. Burglar Alarm; Fred. H. Neal and John R. Donnelly, Fairfield, Me. Application filed March 7, 1892. This invention consists of an elliptical spring and an arm held adjacent to each other, each having its end turned up at right angles to form a flange, the arm and spring being secured to the baseboard by two screws, the flange of the arm being superimposed on the flange of the spring, each of the screws being in electrical connection with one of the flanges, and an insulating plate held between the flanges, the screws being connected with the wires of an alarm circuit.



No. 480,375.—Electric Lighting System.

480,369. Time Cut-Out for Electric Service Systems; Samuel Rush Linville, Philadelphia, Pa. Application filed March 29, 1892. In a time cut-out for electric service systems, a trigger clockwork for tripping same, a switch for cutting out the service circuit, and a bell crank lever connected with the switch and controlled by the trigger.

480,372. System of Electric Lighting; George Francis Myers, Pittsburgh, Pa. Application filed Dec. 15, 1891. The combination of a trolley or contact wheel for electric conductors, two flexible supporting arms carrying the contact wheel, a support to which the other ends of the flexible supporting arms are attached, and latches carried by the support for engaging the flexible supporting arms and holding the contact wheel in an inoperative position.

480,375. Electric Lighting System; Charles Selden, Baltimore, Md. Application filed April 9, 1892. In a system of electrical distribution, the combination with the main line wire, of a Wheatstone bridge interposed therein and translating devices connected in the bridge wire, the resistances of the various arms of the bridge being so proportioned as to furnish the desired current to the translating devices in the bridge wire. (See illustration.)

480,384. Galvanic Battery; Herbert H. Dow, Midland, Mich. Application filed April 4, 1892. In an electro-galvanic battery, the combination of a zinc element, a bibulous sheet moistened with the electrolyte, and a layer of finely pulverized carbon.

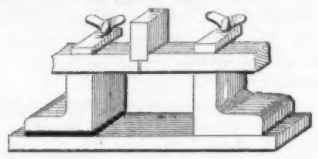
480,392. Method of Electric Soldering; Elihu Thomson, Lynn, Mass. Application filed Aug. 22, 1887. This invention consists in generating heat in the body of the piece or pieces of metal to be united through the resistance of the material to the passage of an electric current through it, such current being of volume sufficient to develop the determinate or required soldering or brazing temperature. (See illustration.)

480,393. Method of Electrical Regulation; Henry E. Vineing, Roseville, N. J. Application filed Feb. 23, 1892. A series of arc lights adapted to operate effectually between specified current limits, a dynamo electric machine in circuit therewith, a primary electromagnetic regulator therefor, and a supplemental electromagnetic regulator provided with adjustable means in the nature of sectional coils for varying the current supply which actuates the primary regulator.

480,409. Closed Conduit for Electric Railways; Alexander Login Lineff, London, Eng. Application filed June 30, 1891. The combination of an electric conductor and a series of separate supports therefor, provided with downwardly projecting annular lips and a continuous series of tiles serving as a base for the supports and provided with oil troughs into which the annular lips enter. (See illustration.)

480,411. Block-Signal Apparatus; Thomas H. Patenall, Rahway, N. J. Application filed Feb. 10, 1892. The combination, with a signal and releasing mechanism of the normally twice-broken electric circuit for plunging to a preceding station and means securing a release of the signal locking mechanism.

480,475. Telegraph Key; Alfred E. McClaren, Joplin, Mo. Application filed April 9, 1892. In a telegraph key, a key base or board receiving the line wires, a supporting rod mounted horizontally upon and over the board, and a telegraph key mounted to slide and rock on the rod, the key being in circuit with and carrying the termini of the relay to be thrown in circuit with any of the line wires on said base or board.



No. 480,392.—Method of Electric Soldering.

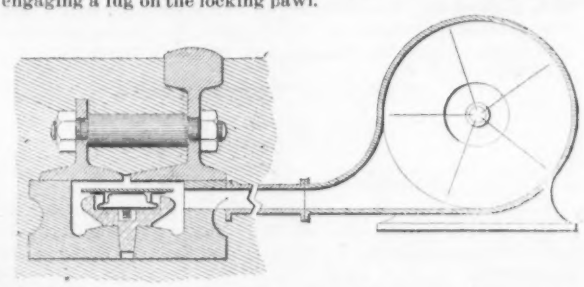
480,507. Circuit Closing and Breaking Device for Railway Traction; Thomas H. Patenall, Rahway, N. J. Application filed Oct. 20, 1891. The combination, with a cylinder, and a plunger for compressing the air within the cylinder, of a movable piece seated in an opening in the end of the cylinder opposite the plunger, a pair of contact plates with which the movable piece is normally in engagement, and a pair of contact plates with which the movable piece is adapted to be thrown into engagement under the impulse of the compressed air within the cylinder.

480,525. Electric Arc Lamp; Elmer A. Sperry, Chicago, Ill. Application filed June 7, 1890. In an arc lamp, the combination of a vertically movable frame with a carbon separating mechanism thereon, containing a clutch supported at one end by toggle bars with a spring from the other end of such clutch to the fixed frame, an intermediate adjustable stop, a main-circuit magnet fixed in position, provided with an armature connected with such toggle-bars, so that the main circuit magnet when energized will cause the carbons to separate, and a fixed shunt-magnet provided with an armature on which the frame is suspended, so that by the action of the shunt-magnet the frame is moved to disconnect the clutch and permit the upper carbon to fall on the lower.

480,539. Support for Electric Arc Lamps; Augustus Wright, Providence, R. I. Application filed April 27, 1891. This invention consists in the use of a rigid lamp-stay pivotally secured to the mast and operated by tackle through a tubular arm rigidly secured to the mast a short distance above the pivoted stay.

480,543. Electric Railway; Francis B. Badt, Chicago, Ill. Application filed Dec. 19, 1891. In an electric railway system, the combination of exposed conductor-rails arranged in sections and adapted to be brought into circuit with the moving motor with insulated main conductors, a series of converters, each having a primary coil permanent in the main circuit and a secondary coil having a part circuit terminating at each end in one exposed rail, the part circuit normally open, and devices to close same on the approach of the car, the devices including a permanently closed conductor between the rails with which the ends of such part circuits are connected.

480,546. Electric Door-Opener; Louis Bates, Jersey City, N. J. Application filed Aug. 13, 1891. The combination, with the main latch having an extended end with a notch therein and a locking pawl adapted to engage the notched end of the main latch, of a spring coiled around the main pivot, one end of the spring pressing against the main latch and the opposite end engaging a lug on the locking pawl.



No. 480,439.—Closed Conduit for Electric Railways.

480,567. Duplex Telegraph; Thomas A. Edison, Newark, N. J. Application filed Sept. 1, 1874. The method herein described of transmitting two distinct messages by separate generators over one wire in the same direction and at the same time, one being transmitted by reversal of the battery-current, and the other by increasing or decreasing the current from the battery.

480,573. Conduit for Electric Wires; Samuel H. Flagg, Providence, R. I. Application filed Jan. 26, 1889. A conduit for electric wires consisting of a metal pipe, a glass pipe of a diameter to exactly fit the metal pipe and somewhat longer than the pipe in combination with a coupling, the interior portion of which forms a continuation of the pipe.

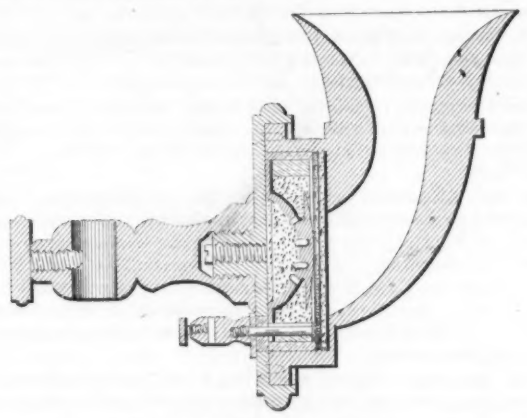
480,575. Electric Accumulator; Giovanni Gandini, Lodi, Italy. Application filed April 15, 1891. An electric accumulator comprising electrodes formed of a mixture of lead oxide and small pieces of carbon having a thin top layer of lead oxide, a porous partition separating the electrodes, and conductors immersed in the mixture constituting the electrodes.

480,576. Method of and Apparatus for Testing Electric Time Systems; William F. Gardner, Washington, D. C. Application filed Jan. 7, 1891. In a time-signal, transmitting system, a transmitting-station, an electric circuit extending therefrom to one or more time signal receiving stations, and a time-signal transmitting apparatus in the transmitting station, the apparatus including a polarized relay, a main line battery and a pole changer.

480,577. Clock-Synchronizing Device and System; William F. Gardner, Washington, D. C. Application filed Dec 13, 1888. In a time-signaling system, a signal transmitting station, a telegraphic or telephonic main-line circuit, a branch circuit adapted to intermittingly connect the signal transmitting devices with the main line circuit, a receiving station, a main line relay or repeater in the main line circuit at the receiving station, a local circuit opened and closed by the relay or repeater, the local circuit having two loops or branches with a battery in each loop, a sounder or equivalent receiving mechanism in one of the loops, a clock or time-signal receiving apparatus in the other of the loops, and a hand switch, whereby the local circuit can be closed at will, either through the clock or through the sounder.

480,644. Telegraph-Transmitter; Charles Willoughby, San Francisco, Cal. Application filed June 30, 1891. In a transmitter, the combination with character plates adapted to move horizontally and levers pivoted to the plates, and spring stops, the levers and spring stops adapted to be operated by finger bars.

480,651. Electric Fuse Box; George W. Baumhoff, St. Louis, Mo. Application filed Dec. 16, 1891. The combination, in a fuse box, of a revolvable drum or block with attachments for two or more fuses, tongues in electric connection with the ends of the fuses, and a door to the box having contact-clips brought in contact with the tongues by the closing of the door.



No. 480,656.—Telephone.

480,656. Telephone; James A. Christy, San Francisco, Cal. Application filed Dec. 1, 1890. In a transmitter, a case having a wire gauze screen over the mouth, an insulating washer resting on the screen, a diaphragm resting on the washer, a metal washer set upon the diaphragm having electrical connections to the exterior of the case and insulating washer set on the metal washer, an insulating ring surrounding the metal and insulating washers, and an electrode having a disc in close proximity to the diaphragm, a perforated dome on which the disc is supported, and a washer in contact with the walls of the case. (See illustration.)

480,673. Electric Low Water Alarm; Ernestie Rothlisberger, Lima, O. Application filed April 18, 1892. An electric low water alarm consisting of an upper and lower case, a sight tub communicating with said cases, an adjustable electric conductor, a spiral conductor connected thereto and having a contact point, a guide for the spiral conductor, and a stationary electric conductor having an adjustable contact point.

480,678. Dental Engine; Charles W. Thomas, Jersey City, N. J. Application filed Oct. 21, 1890. In a dental engine, the combination of a drill and its supporting holder, an electric motor for driving same, connections between the motor and drill, two independent friction gears, and independent connections between the friction gear and a common driving sheave, whereby the direction of the drill can be altered.

480,681. Electrical Spool; Schuyler S. Wheeler, New York. Application filed Dec. 30, 1891. A sleeve or pool for an electro-magnet, consisting of a metallic cylinder or tube held in place by a pair of non-conducting washers, the ends of the inner tube being turned down against the outer faces of the washers.

480,683. Electric Push; John F. Wollensak, Chicago, Ill. Application filed May 10, 1892. The combination of a plate of insulating material, binding screws for holding the ends of the circuit wires arranged on the plate and extending through to the inside, face plate having push buttons and flat springs loosely and removably arranged in the framework for holding the buttons in place, and adapted to be pressed into position by the buttons to complete the circuit.

480,689. Automatic Circuit-Closer for Telegraph Keys; Charles W. Bradford, Clinton, Me. Application filed May 31, 1892. In a telegraph key, the combination, with the lower contact and the key-lever, of a pivoted lever in contact with the lower contact of the key to normally close the circuit, a set screw passing through the key-lever and bearing on the spring, whereby to regulate its tension, and means for moving the pivoted lever out of contact with the lower contact of the key.

480,694. Electric Switch; Jacob S. Gibbs, Hartford, Conn. Application filed Feb. 27, 1892. A switch consisting of a base, fixed and movable poles supported thereon, a handle connected with the movable poles, and a train of multiplying gears interposed between the handle and movable poles, and a spring actuated by the movement of the handle.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.